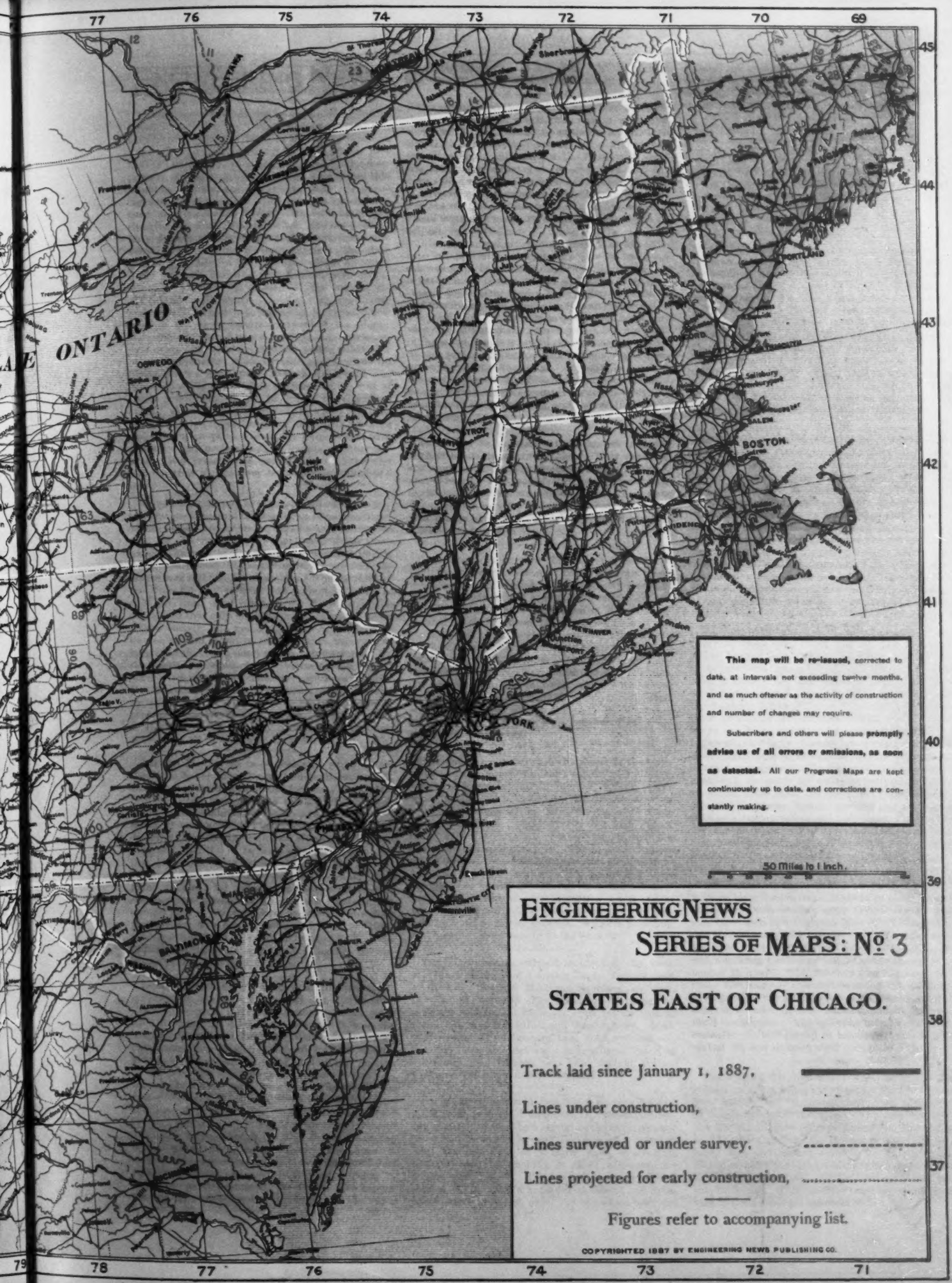

This map will be re-issued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.

Subscribers and others will please **promptly advise us of all errors or omissions, as soon as detected.** All our Progress Maps are kept continuously up to date, and corrections are constantly making.

ENGINEERING NEWS

SERIES OF MAPS: No. 3

STATES EAST OF CHICAGO.

Track laid since January 1, 1887. ———

Lines under construction, ———

Lines surveyed or under survey. - - - - - -

Lines projected for early construction, ·····

Figures refer to accompanying list.

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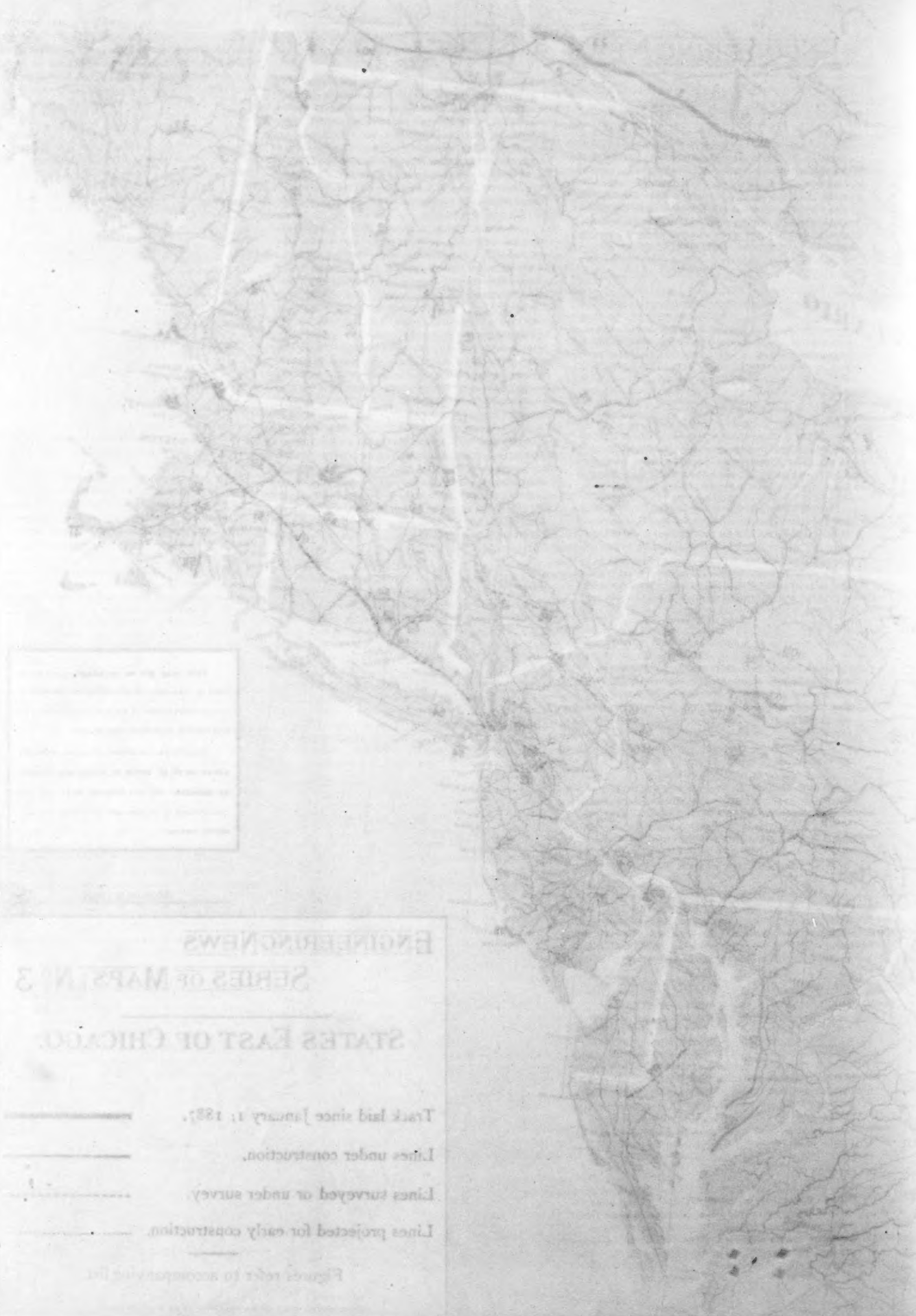


ENGINEERING NEWS

LONDON reports, which are being denied and reasserted, have it that the Viceroy LI HUNG CHANG has withdrawn from the Mitkiewicz-Barker Chinese concesson, and does so owing to the energetic protests of the treaty powers, Germany and England especially. We have already stated that we feared this would be the case, and it would no doubt be pleasing news to certain New York journals which have been jumping on the project with both heels ever since its first announcement. We have not particularly favored the Russian end of the syndicate ourselves, and regret that the active agent in the affair should have been a man against whom so much could be said. But the Philadelphia part of the syndicate is made up of men of the highest respectability, with ample means at their command, and willing and able to do something for the advancement of American interests abroad if the chance were offered them. And we do object, as Americans, to having our schemes pushed aside solely because they conflict with German and English interests in the same field. Before Americans can expect to really accomplish anything in the way of great enterprises, either in China or elsewhere abroad, we must send representatives who not only have our interests at heart but have that training and experience which will enable them to cope with the wily and professional diplomats of other nations. The present case proves that a Mitkiewicz sent out from this country is not the right kind of a man.

MAYOR HEWITT put in a timely and effective protest this week against the tearing up of an additional 23 miles of streets for the laying of a *temporary* conduit for electric wires by the Construction Company. The plea of Commissioner GIBBENS that it would only cost $2,000 per mile proves that the Mayor was right in his objections. This is entirely too little for any efficient and permanent work in this direction. And when, on the other hand, it is considered that only one pole per block would be removed thereby and much pavement would have to be torn up and relaid in the operation, this temporary conduit is too dear, and is not warranted by the results to be obtained. Our telegraph and all other wires should be buried as speedily as possible. But this should be done in a proper, permanent and accessible manner when done at all, even at the expense of doing less in a given time. There is waste of money and not economy in the present practice, for it must all be done over again before long.

ALFRED H. COWLES is to present a paper before the U. S. Naval Institute, at Annapolis, on Oct. 27, on the use of aluminum bronze for heavy guns. Mr. COWLES claims that guns can be made of this alloy, either by the Rodman or Deane process of casting, that will have a much higher tensile strength and ductility than the finest quality of mild steel forgings, and that it will be impossible to burst a gun cast from this alloy with four times the powder pressure now used in "built-up" guns. The plant required for aluminum bronze guns will only cost one-third that for built-up guns and not one-quarter of the time will be required for their production. The cost is estimated at 20 per cent. less than for the other guns and 60 per cent. of the capital will be stored in the guns in metal that can be used over again in other guns.

IN our issue of April 9 we gave an illustrated description of the new water-works at Bridgeport, Conn. The plan includes a tunnel in solid rock, 3,700 ft. long and 6×6 ft. in section. It was the original intention to run the 30-in. main through this tunnel, but Messrs. HULL and PALMER, the engineers of the work, now write us that this portion of the plan has been altered as follows:—The portals of the tunnel have been walled up with solid and water-tight masonry, placed about 50 ft. inside the tunnel portals. The 30-in. main is carried through this masonry but ends at its inner face, and a manhole is provided in the pipe for access to the tunnel when the latter is empty. The tunnel is in very solid and compact rock, and the conditions seem to warrant the engineers in attempting to utilize it as an additional reservoir. The experiment is now awaiting the turning on of the water after the completion of the dam. If the tunnel leaks the 30-in. main will be laid through it.

THE second of the great yacht races was a repetition of the first in result, but not in wind and weather. The wind was high and the sea rough in the last race, but quite as much as in the first race it was a foregone conclusion that the *Volunteer* would win within ten minutes of the start. On the beat out to windward the *Volunteer* gained 14 m. 49¼ sec. in a run of some four hours. On the run home before the wind the *Volunteer* lost 2 m. 54½ sec. in a run of less than two hours, winning the race by 11 m. 54¾ sec. in 5 h. 42½ m.

It is not likely that anyone, unless it be Mr. BURGESS himself, will attempt very soon to build another keel yacht to beat a center-board, although it is rather more than doubtful whether it is really a victory due to center-board or to perfection of model and handling. The *Thistle* itself is an evidence that the possibilities of i type have not been heretofore very carefully studied or developed on the other side of the water, and it is not likely that they have done by any means the best possible in their first serious attempt at really fine design. It would be a matter of great interest if Mr. BURGESS should try his hand two or three times in succession at cutter designing as he has at sloop designing, and the result might be surprising.

There can be no doubt that English yachting authorities of all grades, from Messrs. BELL and WATSON down to the London *Times* are greatly surprised at the result. The tone of their press was exceedingly confident for a month before the race, and the *Times* on the very day before it, renewed its reputation as a prophet by pointing out in detail why the *Thistle* was bound to win.

THIS week's meeting of the American Society of Civil Engineers was one of unusual importance, and was almost wholly given over to Society business. The first business was a resolution offered by Mr. JOS. P. DAVIS that a committee of three be appointed to draft a form for an amendment to the Constitution to put a stop to the evil of malicious black-balling, which has recently attracted so much attention, without decreasing the checks which now exist against the admission of improper candidates. An active discussion followed, which with one or two exceptions was strongly favorable to the proposition, and Messrs. JOS. P. DAVIS, A. M. WELLINGTON and WM. H. PAINE were appointed the Committee to draft a form.

STILL more important was the report of the Committee on forming a Student grade of the Society, which is given in full in another column. The recommendations in brief were that the engineering grades hereafter shall be Member, Associate Member and Student, instead of Member and Junior only, the collateral grade of Associate for men not engineers remaining as now. The present Juniors are to become Associate Members, but the qualifications for both full and associate membership are considerably raised above what they are now, especially in fixing an age limitation of 30 and 24 years respectively. As a whole the report will command almost universal approval, we have no doubt, and result in great benefit to the Society.

THE most serious railroad accident of the week was the derailment of a double-header freight train on the Lake Shore & Michigan Southern Railroad, at Sedan, O., Sept. 30. The accident was caused by a switch which had been left open by the section men. One man was killed and three injured. Both engines and 15 refrigerator cars were wrecked.—Another fatal accident was a tail collision Oct. 3, at Hillsdale, Pa., between two local freight trains. One man was killed and two injured.

An accident occurred October 2, on the Walnut Hills cable railroad, Cincinnati, O., caused (according to a daily paper) by a strand in the cable coming loose and wrapping around the grip of a crowded car. The car went at a rapid pace, overtaking another car and pushing it along although the brakes were put on. The car ran through several streets, till it struck a horse car at the 5th and Sycamore street crossing, when the three cars were derailed; the wrench to the cable being so great that every car on the track as far as Walnut Hills was derailed. One man was fatally hurt and several others were injured more or less seriously.

The following bridge accidents are reported: On Sept. 27 the Arno trestle, a few miles south of Elk Grove, Cal., on the Central Pacific Railroad, was destroyed by fire. Trains were delayed for 10 hours.—On Oct. 3 an iron bridge over the Black river at Watertown, N. Y., fell while being repaired. Three men were injured. The loss to the city is said to be about $2,000.

A CURIOUS accident, near Fern, on the Indianapolis & St. Louis R. R., carries an evident moral. The locomotive truck was derailed by a small stone in a crossing plank, and ran all right for 1,140 ft., or nearly a quarter of a mile, when it was derailed by striking a switch. The engine was equipped with a steam brake, and the train could easily have been stopped by it, but the engineer was afraid to apply it with any force from a very reasonable fear that the train would so crowd up upon him as to land his whole train in the ditch. Brakes which apply uniformly throughout the train, and which are on all the cars, are the only ones which can make the handling of freight trains as safe as it should be.

ANOTHER runaway locomotive in Oswego has almost duplicated the experience in the Philadelphia yard a few weeks ago. An excursion train (how often it is an excursion train) ran into a yard engine and knocked its throttle open. It bounded up the yard at very high speed, hit and completely wrecked an engine in its way, being substantially uninjured itself (a fact which we commend to the attention of those who remember the "Question of Dynamics" raised in these columns about two months since) and then ran into a passenger train. Less harm was done than might have been expected, but it should not be so easy to throw open a throttle by the momentum (or rather inertia) of its parts.

WE note with considerable satisfaction that the Ingersoll Rock Drill Co. of this city has just shipped to foreign countries the following plants:—To the order of the Devala-Moyar Gold Mining Co., with office in London, for their mines in India, a complete air-compressor and Ingersoll drill outfit; and for the Lancudo Mines, U. S. of Colombia, a complete plant of duplex air-compressors and drills. These latter are to be operated by water-power and the Ingersoll Company furnish everything from the power machinery to the mines. As the plant must be transported about 100 miles over rough roads on muleback the parts are made in sections, no piece weighing more than 100 lbs. The Saint Raphael mines of Zacatecas, Mexico, are also being supplied with an air-compressing and drill plant. This speaks well for the popularity of American drilling and air-compressing machinery, and is the best kind of recognition of its efficiency by foreign users.

THE Kansas City tunnel, which has just been "holed" is 800 ft. long, double track, 22x19 ft. in the clear, and on a down grade of 8 per cent. Double gangs of 65 men have been at work since May 10. The material has been a mixture of lime-stone, slate, shale, clay, and mud seams, and the roof has been wet throughout, requiring timbering for its whole length with bents 3 ft. apart. The weather also has been very wet. The progress toward the end of the work was 15 ft. per day; the average rate 6 ft. Three Ingersoll drills were used in each heading, and an Ingersoll 16x24 compressor. The spoil has been hauled about one mile. It is expected to have the bench cleared up Oct. 10, and all brickwork completed Dec. 15.

THE subject of a ship-canal from Lake Erie to Cincinnati is again being discussed by the Ohio press. Two routes are suggested, one from Cincinnati to Toledo by way of the Miami Canal, and the other *via* the Muskingum river to Zanesville, and thence by the Ohio Canal to the Cuyahoga river at Cleveland. The preliminary surveys for enlarging the Miami and Erie canals have already been made by the U. S. Engineers (1881), and the total estimated cost was $28,557,178. This enormous cost has stood in the way of Congressional approval so far.

A CORRESPONDENT of the *Scientific American* claims for GEORGE MAGERS, of Maryland, the honor of designing and laying the first railway built in this country. This was at Falling Waters near Richmond, Va., in 1814-16; the road was used for hauling powder from the mill to a magazine a couple of miles away, and was operated by horses until 1818. While this antedates the Nashua, N. H., road of 1825, and the Quincy tramway of 1826-27, it was *not* the first railway in the United States as claimed. Mr. THOS. LEIPER, in Nov., 1809, commenced building a railway from his quarries on Crum Creek to his landing on Ridley Creek, in Delaware Co., Pa., finished it early in 1810, and the road was in active use until 1828. It was laid with cross-ties, white-oak stringers and strap rail, and the cars used had cast-iron flanged wheels.

THE Consolidated Transit Co., of Philadelphia, which was organized last June for the purpose of erecting an elevated railway in that city, went into court this week and asked that the affairs of the company might be wound up. This is the "Wanamaker" road which started out so bravely with the intention of covering 40 miles of streets with $30,000,000 worth of elevated structure, but was most vigorously opposed by the citizens along the proposed line of road. Philadelphians want elevated railways, but they want them "on the next street;" and as every one is of this same way of thinking, the Consolidated Transit Co. has evidently given up the solution of the conundrum.

THE highway grade crossing question continues to be actively agitated in various parts of the country, notably at Buffalo, N. Y., and in Connecticut. At Buffalo the Board of Trade is keeping up the fight by the following very sensible resolution:

Resolved:—That in the opinion of the joint committees the only feasible and practicable system for the entry of the railroads into this city is by elevating tracks and depressing streets, but we advocate as the minimum of our demands the report of Mr. SPENCER, with the addition of elevating the Erie tracks at Seneca and Smith streets and depressing said streets as far as practicable.

In Connecticut, the New York, New Haven & Hartford is showing, on the whole, a very liberal spirit. It cannot be many years before grade crossings are almost wholly abolished in that State, as they ought to be. The country has outgrown the dangerous abuses which exist in almost all our large cities, and there is no longer excuse for them in lack of means.

KEELY has a rival, and had better make another assessment on his stockholders and give an exhibition of his motor at once. The new aspirant to fame is a Mr. L. C. WELTNER, of Uniontown, Pa., and he claims to have a "pneumatic generator of motive power" that will run as long as the metal holds together, and cost no more to run than the "sarpints" of the showman which "consisted hentirely on the hatmosphere." His invention consists of a series of tanks ranged about an air-pump in such manner that the air-pressure is increased in a rapidly ascending ratio until "a generator 5 ft. sq. will run a Mississippi tow-boat." We have failed to hear that the machine has passed beyond the stage of elaborate plans and an application for a patent.

A LARGE-SIZED project has recently been brought before the French Government by parties having some shadow of responsibility;—to build a channel bridge in spans of 500 metres, or 1,640 ft. in the direction of Cape Gris Nez from Dover, the total cost being estimated at some $220,000,000, and the probable revenue at $20,000,000 per year. As Cape Griz Nez is nearer to Dover than Calais, and directly opposite, it should be about 20 miles across instead of 22½ miles, and the water is also shoaler. This would necessitate about 64 spans of the kind proposed, which would make the estimated cost per span something less than $3,500,000, equivalent to about $4,500,000 at American prices. We are not prepared to say that the spans in such number cannot be built for the money,—although we have no present desire to be given the contract. The tunnel project should be vastly cheaper, but the military objections, which have alone impeded the construction of the latter, would hardly apply to a bridge, which could be so readily destroyed by any man-of-war.

The Lachine Bridge.

We continue our illustrations and description of this fine structure by giving herewith a view of the complete structure as erected, which brings out very clearly, it seems to us, how great an improvement it is, in an artistic sense, on the ordinary hideous combination of through and deck spans, as well as the general proportions of the structure.

This question of appearance is one which very many engineers are disposed to consider too lightly. Especially near cities, there is even a direct money value in combining architectural harmony with strength, besides which, it is the rule rather than the exception, that large engineering structures might have their appearance much improved without in any way increasing their cost, as is the case with the present structure. We suspect that convenience of erection rather that aesthetic qualities had the chief part in the choice of this design. It obviously possesses great advantages for erecting long spans over deep running water, where falseworks would be costly or impossible, and was no doubt cheaper, if not also lighter, than the ordinary disconnected through spans would have been.

This being so, it is still more gratifying to observe the graceful and pleasing lines of the structure, which make the transition from deck to through spans and back again—a positive element of beauty instead of an unsightly blotch. This is not because the eye mistakes these through spans for arches, for it does not, nor do they make any pretense of being such in their constructive lines. They are recognized for what they are—continuous girders, with their central part raised to give more headway. That sense of incongruity which always comes and excites a certain feeling of displeasure when a construction purports to be what it is not is entirely absent from this bridge, the graceful effect of which is hardly done justice to in our engraving, as we can testify from personal inspection of the bridge from every point of view. To merely obtain a fine picture, a more distant view of the structure should have been taken, but to make its details clearer, the view which we give seemed best.

As the first bridge which has ever been erected on this plan the structure possesses great interest. There may be objections to the plan as a standard for general use which we do not perceive, but unless there are such, of a much more serious nature than a difference of a small per cent. in cost, we hope it may become the standard type for such structures everywhere, as its merit and beauty seem on their face to demand. There are already great numbers of them, and there will be many more. Both through and deck spans must almost always occur, for the reason that most of the structure is apt to be over shallow water, where it would be a clear waste to use any other than deck trusses, while it is still more likely that there will be one to three spans in the center over a navigable channel, where it is necessary to have all the headway possible, and hence nothing else but a through span can be used. The offence to the eye from the ordinary combination comes from the *abrupt and sharp* right-angled break in the lines of the structure, destroying that sense of unity and homogeneousness which is essential for pleasing effect. This secured, as it is in Mr. C. SHALER SMITH'S design, the change by graceful curves from absolute right lines is as pleasing as the other is unpleasing.

In the distribution of strains in the structure, the dead weight is cantilevered, as shown by our last week's illustrations. As respects the additional live weight the structure acts as a continuous girder over four spans, thus considerably reducing the necessary sections. Objections are made to this diversity; but without attempting to be dogmatic in respect to so nice a point, it appears to us that the objections are rather hypercritical.

We give below the first part of the rather long discussion of Mr. SCHAUB'S paper, which we printed last week. Next week we will give the conclusion of this discussion, which appeared to be of too interesting a character to abbreviate much, and also some fuller detail drawings of the bridge, for which we are indebted to Mr. FRANK D. MOORE, Mr. SMITH'S former chief assistant, who has recently compiled full details in regard to the structure. In the same issue we shall discuss some of the details of the structure more fully, especially in respect to its surprising contrast with the old Victoria bridge, in weight, cost, beauty, convenience and quickness of erection, and character and cost of masonry.

DISCUSSION.

Mr. M. J. BUTLER.—Mr. SCHAUB'S very interesting description cannot fail to be received with pleasure by the members of the Society. It is to be hoped that the description given is but the prelude to a more elaborate monograph, giving in full details all the particulars relating to the design of the bridge, similar to the admirable papers prepared by Mr. GEO. S. MORISON on the Plattsmouth and Bismarck bridges, and by Mr. SCHNEIDER on the Niagara Cantilever.

The novel and interesting features of this bridge are of course, the continuous girder of such great length resting on five supports, and the pleasing and ingenious method of passing from a through into a deck bridge. In the absence of the plates it is a little difficult to follow the description clearly. It seems that Mr. SCHAUB has drawn attention to an important defect in the construction of double intersection Pratt trusses and one which I have never seen alluded to before. In all such bridges, each system is supposed to act independently, yet it is perfectly obvious that where the long diagonal is coupled to the post of the other system ("Where the pin shall fit its hole within the $\frac{1}{64}$th of an inch"), unless the workmanship is mathematically correct, the whole or a part of the load may be transferred to the post of the other system, or else so pull the post out of its place that the other half of the diagonal may do its work. The function of the pin at the center of the post should be merely to couple the two halves of the diagonal, and to hold them in place, thus preventing the excessive vibration that would naturally occur in such long slight members. In view of the fact that rails 60 and 90 ft. long have been rolled, would it not be better to have these long diagonals rolled in one piece, and hold them against the side of the posts by some simple device, thus obviating the necessity of pin and hole, with its reduction of section and expensive reinforcing of all long posts.

Of course, it may be said that the pin also seems to shorten the post, but when provision has been made for the effects of the distortion, due to the cause mentioned by Mr. SCHAUB, it is difficult to see how it could be so considered. His point therefore seems well taken in questioning the practice of "figuring the posts for half their total length, and consider them as fixed ended, when they are held by the diagonals at the center."

Owing to the necessary alternating stresses, to which many of the members of the continuous girder are subjected, it would seem that this was a case peculiarly well adapted for the use of LAUNHARDT'S and WEYRAUCH'S formulæ.

The designers of the St. Lawrence bridge, by the adoption of mild steel throughout, have disarmed criticism, and have created a valuable precedent on this Continent.

The steel used in the Bismarck bridge for compression members had an ultimate strength 80,000 to 90,000 lbs. per sq. in., with an elastic limit of from 49,600 to 65,000 per sq. in., with an elongation of from 12.75 to 21.25 per cent. in 8 ins.

The steel used in compression members of the Niagara cantilever ranged from 79,300 to 89,980 lbs. per sq. in., for ultimate strength, with an elastic limit of from 49,450 to 65,780 lbs. per sq. in., with an elongation of 18.25 to 22.75 per cent. in 8 ins., and a reduction of area of 41.2 to 37.7 per cent. Such high grade steel was very difficult to get, and consequently cost very much more than a milder type would have done.

The recent experiments in England, on the effect of cold on steel axles, also go to show the disadvantage of the higher grades of steel where subjected to extremes of temperature.

It would be interesting and valuable to compare the weight of the channel span with the 400 ft. span of the Bismarck bridge, noticing also the deflection under a similar test load to that adopted in the testing of that bridge.

Mr. G. BOUSCAREN had seen the designs for this bridge at the time they were being prepared in the office of his late friend SHALER SMITH.

Whatever may be said as to the economy of the general plan, he thinks that it solves the local difficulties which had to be contended with, in a very elegant manner, and is well worthy the name of the designer.

He was very glad to see the tribute paid to SHALER SMITH, as one of the earliest promotors of the use of cantilevers in bridge construction in the United States.

The idea of fixing the points of contra-flexure in continuous girders was first suggested by Professor CULLMAN in the first edition of his graphical statics; it was subsequently applied by GERBER and other European engineers, as early as 1866 and 1867. Its first advocate in the United States, he believed, was LOUIS NICKERSON, of St. Louis, known by his ingenious experiments on glass beams; but to SHALER SMITH belongs the claim of priority in its application, as made in the Kentucky River

C. Shaler Smith, Engineer.

Dominion Bridge Co., Contractors.

LACHINE BRIDGE, ON CANADIAN PACIFIC RAILWAY,
CROSSING THE ST. LAWRENCE RIVER
AT LACHINE, QUEBEC.

bridge in 1876. Speaking of this structure Mr. SCHAUB says: "These points of contra-flexure could have been "fixed in the river span instead of the shore arms, and it is a curious "fact that they should not have been fixed in the river span." Having co-operated with SHALER SMITH in the designing of this bridge as Principal Engineer of Construction" on the Cincinnati Southern Railway, he would ask to be permitted to explain why the hinges were placed in the shore spans.

One of the principle objects sought in fixing the points of contra-flexure is to avoid the reversions of strain, which take place in the different members of the continuous truss with the displacement of the load. In a continuous girder of three equal spans, it is quite clear that this object is better served by hinges in the shore spans, whereby the directions of strains are fixed in *two spans*, and reversible *in one* only, whereas the contrary would be the case if the hinges were located in the middle spans.

It is only when the shore arms are much shorter than the middle span, and the initial strains in the short spans from the dead weight of the middle span preclude reversion to a very large extent, that the hinges in the middle span become advisable in point of economy. Such is the case in Mr. SCHNEIDER'S bridge over the Niagara.

Mr. W. B. DAWSON.—The theorem of the three moments was discovered by M. BERTOT in 1885. In applying it to a continuous girder of any number of spans, it takes the form of a number of simultaneous equations, and the general solution of these is due to CLAPEYRON. The theorem in its original form assumes the load to be uniformly distributed over the extent of each span. This is satisfactory for riveted structures, to which it was first applied, but is not convenient in the case of pin trusses in definite panels, where the loading is at isolated points, and usually varies from one panel to another in the course of the same span. A modified form of the equation makes it applicable to the case of isolated loads. It has always seemed to Mr. DAWSON safer to work directly from the general equation, rather than to use formulæ derived from it.

It is very desirable that a bridge in which the chords are cut should not be called "continuous," as the cutting of the chords is the essential difference between a continuous girder and a cantilever. The advantages of doing so, are, that reversed strains, for which pin trusses are less adapted than riveted work, are almost entirely avoided, that any slight inequality in the levels of the piers, due to inaccuracy in setting out or to settlement afterwards, does not effect the stresses as originally calculated, and also that the expansion for temperature takes place under better conditions.

The cantilever principle is eminently applicable to pin trusses, as they have hinged joints already supplied by the pin connections, and there is greater difficulty in making them act satisfactorily under expansion for temperature when they are continuous than in the case of riveted girders.

The method of allowing a continuous girder to act as a cantilever during erection, is a favorite one in France, and presents undoubted advantages. It is there used in erecting high viaducts, which are pushed forward from one bank as built, the forward end acting as a cantilever for the whole length of a span, until the next pier is reached.

With regard to the effect of a variation in the moment of inertia of a girder, a gradual change in the depth appears to have no appreciable effect in modifying the stresses. In taking out the stresses in a draw span of 396 ft. total length for the Sault Ste. Marie bridge, in which the top chord has an inclination of nearly 1 in 12, the moments at the center and the reactions were calculated directly from the theorem in question with the assumption it involves, and yet in working out the stresses in the individual members by the graphical method, no appreciable error could be detected in the closing of the figure.

It seems safe to say in such a case that the stresses, as thus calculated, are within 1 per cent. of the absolute truth, as far as the questions of theory involved are concerned. In the case of a swing of the triangular design, such as that erected over the Lachine canal, the want of coincidence might well be greater, owing to the more rapid variation in the depth of the truss. The problem of the distribution of the weight of the swing, when open, around the rim of the turn-table, is one of much interest, and would deserve separate discussion. In the Sault Ste. Marie swing, designed by the Detroit Bridge & Iron Works, this has been attained by bringing the weight down upon radial beams in the drum, which, so far as this particular object is concerned, is an excellent method.

Mr. DAWSON then expressed the wish that further explanation should be given with regard to the expansion of the bridge from temperature; and also the effect in modifying the strains of the adjustment as between the dead and live loads.

Mr. PETERSON stated that he had always intended to prepare a paper himself, covering the entire question of the bridge, and hoped to have had Mr. C. SHALER SMITH'S assistance upon the continuous portion of the superstructure, the general design and detail of which are due to him. He regretted exceedingly that Mr. SMITH had not been spared to see it finished.

At present, he proposed to give a sketch of what was done before the date at which Mr. SCHAUB takes up the matter, and to state some facts regarding the early history of the work which Mr. SCHAUB had not been in a position to become acquainted with.

On receiving the appointment of Chief Engineer of the bridge in September, 1881, a report on the bridge was submitted to Mr. PETERSON, together with a rough chart made by the late Col. ROBERTS, past President of the American Society of Civil Engineers, who had been employed by the late Sir HUGH ALLAN, then the President of the Northern Colonization Railway, and who was about to undertake the construction of the Canadian Pacific Railway.

Col. ROBERTS reported very fully, and made estimates upon a great number of crossings, but gave a preference to the crossing at Isle Heron; and for this reason, as well as from the fact that the company had purchased a considerable tract of land near what would have been its Northern terminus, the Directors desired Mr. PETERSON first to make a survey of this crossing. He made careful surveys of this crossing, of one at Nun's Island, of another below the Victoria Bridge, and lastly of the present crossing at Caughnawaga, which Col. ROBERTS had not examined. After thorough surveys of all these crossings had been made, and careful estimates had been prepared, he found the Caughnawaga line to be very much the cheapest. His estimate for a double track bridge from grade to grade for the Isle Heron line was $2,176,475; for the Nun's Island line $2,946,186; and for the Caughnawaga line $1,407,373.

He reported in favor of the Caughnawaga line, as he considered it preferable from an economical point of view, as well as from its position, which gave the shortest line between the west and the Atlantic seaports, and at the same time an easy entrance into Montreal. This report was adopted by the Board of Directors, in January, 1882, and plans were approved by the Railway Committee of the Privy Council in the following April.

This design had ten deck spans of 300 ft. in the clear, and one through span of 330 ft., with a clear headway of 60 ft. above ordinary summer water. The bottoms of the deck spans were placed 30 ft. above ordinary summer water.

Although he adopted 300 ft. spans at this time, he was well aware that it was not the most economical design. This length was chosen in order to obviate any difficulty in connection with the Government approval of the plans, as the directors were under the impression that there would be a considerable amount of resistance to bridging the river at this point, on account of the damage which it was supposed by some would be caused by the holding back of the ice, and the flooding of the country above, while it was also suspected that objections would be made by the lumbermen as interfering with the running of rafts.

No further steps were taken towards the construction of the bridge until the spring of 1883, when, after seeing the ice pass out, new plans were submitted to the Government, with 12 spans of 250 ft. and one of 330 ft. The latter length was required for the channel span by the charter, which gave a saving of about $75,000. This arrangement of spans was objected to by the pilots engaged in running rafts down the channel, and in order to meet their views, Mr. PETERSON arranged to change the plan to eleven spans of 268, and one span of 340 ft., but nothing further was done towards commencing the work at that time.

Mr. C. SHALER SMITH was called in as consulting engineer for the superstructure in the summer of 1884. He apprehended much greater difficulty in the construction of the piers in deep water than Mr. PETERSON did, and suggested that in place of the eleven spans of 268 ft., and one span of 330 ft., then proposed by the latter, there should be introduced two spans of 258 ft. and two spans of 408 ft. over the channel, thus getting rid of one deep water pier, and probably one year's time in the construction of the bridge; the complete design thus embraced eight spans of 252 ft., two spans of 269 ft. 10 ins., and two spans of 408 ft., center to center of piers in each case. With these arrangements the 252 ft. span extended further over the shore than Mr. PETERSON considered safe, on account of the tendency of the ice to shove on the shore and lift the span out of position. To obviate this, the 252 ft. spans were changed to 242 ft., which gives the arrangement of the span as it has been executed.

Tenders were not called for the construction of the work, until a year after this, September, 1885, when Mr. PETERSON asked in his specification for prices based upon the following arrangements: eight spans of 242 ft., two spans of 269 ft. 10 ins., two spans of 408 ft. all center to center, and also nine spans of 268 ft., two spans of 269 ft., and one span of 340 ft. center to center, stating at the same time that tenders and plans would be received for any other arrangement, providing the position of the east pier of the channel span was not changed, and that no piers were placed closer than 242 ft. center to center. Plans were sent in by the Union Bridge Co. of New York, the Dominion Bridge Co. of Lachine, and the Phœnix Bridge Co. of Phœnixville.

The Dominion Bridge Co., sent in a tender, based upon the arrangement of the long spans suggested by Mr. C. SHALER SMITH, and this was accepted; but before the contract was signed, Mr. PETERSON had the floor system changed, so as to place it between the trusses, instead of on top, as he considered this would make a much more compact bridge, and by the arrangement the top chord would form admirable guard rails, and render the bridge absolutely safe for a derailed train, while it would, at the same time, improve the appearance of the structure. With this latter view, he also had the top chords in the curved portion, where they were built of eye bars, cased in so as to give them a uniform width and appearance throughout.

The adoption of the two 408 ft. spans did away with one pier in deep water, which Mr. C. SHALER SMITH convinced the Directors was a very important consideration in the rapid completion of the work. He thought that the greatest difficulty and delay would be in the construction of the deep water piers. Mr. PETERSON was not of this opinion, and apprehended no great difficulty in the work, nor did he apprehend that there would be any serious difficulty in erecting the channel spans from false works in the river. The result would go to prove that the fears entertained, regarding delays likely to arise from the deep water piers, were to a great extent groundless, as the masonry was finished nearly a month in advance of the contract date, viz., Nov. 30, 1887, whereas the superstructure, about which it was supposed there would be no difficulty, is not at this date completed.

The method of equalizing the pressure on a turntable by means of a rocker-link was adopted in 1878, in the truss of a counterbalanced swing-bridge, erected by Messrs. CUNNINGHAM and KEEPERS of the Milwaukee Bridge & Iron Works. The posts over the main bearings are inclined and riveted to a strong plate, which carries a pin *B*. The top chords and bars are attached to a pin *A*. *A B* is a short link which transmits the whole load to the main posts, and, however, unequally the arms may be loaded, there will be an even distribution of pressure on the turntable. Imperfection of workmanship will modify this result to some extent, which could only be absolutely true when the line of action of the resultant load coincides with the axis of the link and bisects the angle between the inclined posts. [See cut in last week's issue.—ED.]

What the author calls the Rankine-Bouscaren formula would, perhaps, be better described as RANKINE'S modification of GORDON'S formula, the coefficients being those adopted by BOUSCAREN. RANKINE substituted the ratio of length to least radius of gyration, for the ratio of length to least dimension in GORDON'S formula, and thus eliminated the variation due to a change of sectional form.

Very elaborate calculations seem to have been made in order to determine the stresses in the different members of the double-intersection trusses; but it is certainly impossible to determine these stresses with any degree of exactness, and under a moving load the diagonals are subjected to wide variations of stress, and, therefore, require a proportionately greater sectional area. The live loads to be allowed for are also continually increasing, and it seems useless to calculate for a particular distribution of loads on engine wheels. Indeed, the opinion seems to be gaining ground that it would be practically as well to design a bridge for a uniform load, say of 3,000 lbs. per lin. ft. with an excess of 25,000 lbs. concentrated at the head. Floor-beams and short spans may then be designed for two loads of 40,000 lbs. on a 14 ft. wheel base (or on axles 7-ft. apart). One great objection to almost all pin-connected bridges is that the safety of the bridge depends upon the strength of individual members. This has been made painfully evident by recent bridge accidents, which would certainly not have occurred, had the members been riveted together and made, to some extent, mutually dependent, as is the common practice with European engineers.

The most striking feature, and the one most naturally subject to criticism in the St. Lawrence Bridge, is the bold and novel method adopted for passing from the deck to the through spans. The design originally proposed by Mr. PETERSON, the chief engineer, in which the piers for the deck spans were to be carried up sufficiently high to support the ends of the ordinary disconnected trusses, certainly possesses many substantial advantages. It does away with the necessity of curving the lower chords at the haunches, and, therefore, also with the precautions which have had to be taken in providing against the excessive straining which such curving induces.

It would be interesting to know why the original can-

tilever design was departed from, and the continuous girder system adopted.

The former possessed the advantage of rendering possible a definite determination of the stresses, while in the latter the movement of the points of contraflexure under a live load considerably complicates the problem, and renders its solution extremely difficult.

The formulæ given by Mr. SCHAUB for the moments and shears in the case of continuous girders are based on certain assumptions. Recently, in a paper before the Royal Society of Canada, Prof. BOVEY has deduced formulæ somewhat simpler and more easily applied in practice, the assumptions being the same.

The bending moment upon the rth pier counting from one end, under a load upon the rth span, there being n spans in all.

$$\text{is } \frac{a^r}{a^r-1}\cdot\frac{B-cA}{bc-1} \text{ if } q<r$$

$$\text{and } \frac{a^{n-q+1}}{a^{n-r+1}-1}\cdot\frac{A-cB}{bc-1} \text{ if } q>r$$

$$\text{where } A=\Sigma\frac{w\,p}{l}(l^2-p^2),\ B=\Sigma\frac{w\,p}{l}(l-p)(2l-p),$$

$$b=4-\frac{a^r-1}{a^r-1} \text{ and } c=4-\frac{a^n-r}{a^{n-r+1}-1},$$

the co-efficients a being determined by the law.

$a_1=1,\ a_2=x,\ a_3=4a_2-a_1=4x-1,\ a_r=4a^{r-1}-a^{r-2}$.

It also at once follows that the bending moment at any pier is a maximum when the two adjacent spans and then every alternate span, counting in both directions, are loaded, and the remainder unloaded. The inclination of the neutral axis has been neglected in the calculations of the St. Lawrence bridge, but the modifications introduced thereby, would, in all probability, be too small to be of any serious account.

(TO BE CONTINUED.)

Railway Trestles.*

Temporary or Permanent.—In building railways a ravine or bottom can often be crossed much cheaper with a temporary trestle than with an embankment: but when the line is built, and the time arrives for renewing the trestle, it may then be cheaper to fill than to rebuild. On the other hand, there are always cases where extreme height makes an embankment an expensive luxury, or where a water-way or passage way must be kept open below the grade of the road, making filling out of the question, and here the trestle work must be always maintained. Hence, railway trestles are naturally divided into the classes, temporary and permanent.

Whether in a given case we should adopt an embankment, a temporary or a permanent trestle, involves a comparison of their respective costs. As between embankment and trestle work, the latter can be quickly constructed, and is often used when time is an object, or because it is cheaper. In such cases it is usually intended to replace the trestle with earthwork after the completion of the road, when filling can be done for less money, owing not only to increased facilities for handling and transporting material, but also to the fact that by the time the trestle needs renewal the cuts and ditches usually need cleaning out, and this material becomes available for filling purposes.

Assuming the average annual expense of maintaining a wooden trestle at one-seventh of its first cost, which is 5 per cent. interest on a sum equal to about three times its first cost, then evidently we are justified in building embankment, or temporary trestle and embankment, costing three times as much as a permanent wooden structure.

Our comparison will then be between:

1st. The cost of an embankment.

2d. The cost of a temporary trestle plus the cost of filling after completion of the road.

3d. About three times the cost of a permanent wooden structure.

4th. The cost of a permanent iron structure.

Whichever plan is in the long run most economical should be adopted, though we are always justified in incurring a reasonable extra expense, if thereby we can substitute embankment for trestle, particularly so, when funds are available and high-class work is called for. Where, however, cheapness in first cost is a "*sine qua non*," the temporary structures, though eventually the dearer, must be adopted because they cost less now, the policy of the management being for the future to care for itself.

Permanent trestles are mostly confined either to lofty structures or to structures over marshes, rivers, ponds and bottoms subject to overflow, or over railways or highways. VOSE says that, "The height at which a trestle becomes more economical than an embankment depends much on local conditions affecting the price of earthwork, and ranges from 25 to 50 ft." High trestles are usually iron structures, and when built of wood are the subject of special design; neither can be properly treated within the limits of this paper. I shall therefore confine myself to the subject of pile and frame trestles of moderate heights.

The several bents which support the stringers of a trestle correspond to the piers of a bridge supporting its several trusses. These bents may be of piles, properly braced; or a frame-work of timber resting on suitable foundations, forming respectively, the two well-known types, pile and framed trestles.

Pile Trestles.—The number of piles per bent varies from two to six, but less than four is not good practice. The proper number depends upon the load sustained, varying with the span, which for moderate heights is rarely over 16 ft. from center to center of bents. In the west 15 to 16 ft. between centers and 4 piles per bent is ordinary practice, while on eastern roads 12 ft. is the usual span and 6 piles per bent are sometimes used. The ordinary range of practice is from 4 to 6 piles, diameter from 10 to 18 ins., spaced from 12 to 16 ft. center to center.

Sustaining Power of Piles.—In the following formulæ:

D, (ins.) = Diameter of large end of a round pile.
d, " = " " small " " " "
h, (ft.) = Height of fall of ram.
s, " = Last penetration of pile.
s_1, (ins.) = " " " "
C, (lbs.) = Crushing strength per square inch of pile timber.
w, (lbs.) = Weight of ram.
p, " = " pile.
L, " = Safe load per pile.
L', (tons) = " " "
f, = Factor of safety.

TABLE OF FORMULÆ.

Sought.	Weight of Pile Considered.	Wt. of Pile Neglected.	
	Weisbach and Mason.	Weisbach and Sanders.	Sager.
L = Safe load.	$L=\frac{w_2\,h}{s\,(w+p)\,f}$	$L=\frac{w\,h}{f\,s}$	$L'=\frac{\sqrt[3]{h\times\frac{1}{40}\,w}}{(s_1+1)\,f}$
s = Last penetration in feet.	$s=\frac{w^2\,h}{L(w+p)\,f}$	$S=\frac{w\,h}{L\,f}$	
s_1 = Last penetration in inches.			$s_1=\frac{\sqrt[3]{h\times\frac{1}{40}\,w}}{L'\,f}$
f = Factor of safety.	$f=\frac{w^2\,h}{L(w+p)\,s}$	$f=\frac{w\,h}{L\,s}$	$f=\frac{\sqrt[3]{h\times\frac{1}{40}\,w}}{(s_1+1)\,L'}$

ORDINARY VALUES OF f.

In crushing formula $f=10$.	$f=$ from 6 to 10.	$f=$ from 7 to 12.	$f=$ from 2 to 5.

For safety against crushing we must have

$$L<(D^2+d^2)\times\frac{.3927\ C}{f}$$

CONSTANTS FOR CRUSHING STRENGTH OF PILES.

TIMBER.	Crushing strength Lbs. per sq. in.	Value of .3927 C.	Logarithm .3927 C.
Red and White Ash and Elm	6800	2670.2	3.426511
White Cedar	4400	1727.9	3.237544
Chestnut and Hemlock	5300	2081.3	3.318272
Black, Red and White Oak and Beech	7000	2748.9	3.439175
Scrub Oak, Red Cedar and Buttonwood	6000	2356.2	3.372175
White Pine	5400	2120.6	3.326541
Red or Norway Pine	6300	2474.0	3.393400
Pitch Pine	5000	1963.5	3.293141
Georgia Pine	8500	3338.0	3.523486

The preceding formula for crushing strength is modified from one given by Mr. HERING, and f should not usually be taken less than 10. The above table of constants is based on TRAUTWINE'S data, and will facilitate computations. In all ordinary cases, however, piles are amply safe against crushing.

The formulæ of the preceding table apply only when the pile is sustained solely by the lateral friction of the soil. When driven to a solid foundation, such as rock or hard pan, the safe load should be found by the rule for the strength of columns.

The various formulæ for the sustaining power of piles give somewhat conflicting results. Formulæ based like the above on the last sinking of the pile under a known weight falling a given distance are considered the most reliable. Mr. SAGER'S formulæ were submitted to this society last year and closely resemble those of TRAUTWINE, who takes exceptions to SANDER'S formulæ. TRAUTWINE'S remarks on this subject and Mr. SAGER'S paper on pile foundations can be consulted with profit; and particular attention is called to the pamphlet of Mr. R. HERING on "Bearing Piles," where a good comparative summary of all the principal formulæ will be found. Mr. HERING recommends MASON'S and SANDER'S formulæ, preferring the former. In general, he advises f taken at from 3 to 5 for temporary work, from 6 to 10 for heavy work, especially in clayey soils, and when bents are subjected to vibration and for very important cases or unreliable ground still higher values. SANDERS, he considers the least reliable, and I think should be used with higher value of f. In ordinary trestles for railways, with MASON'S formula, f should not usually be less than 8 to 10. In this formula the values of p can be computed from TRAUTWINE'S data. Generally, round piles, as they average in trestles, will vary in weight from 20 to 50 lbs. per lineal foot depending upon kind of timber, dimensions, and whether green or well seasoned.

In SAGER'S formula f varies from 2 to 5, the latter value being suited to railway work. Mr. SAGER remarks that no rule correctly applies to all conditions and circumstances, but considers his own a fair average rule for the majority of cases. The rules are usually unreliable in mud and quicksand and in clayey or other soils readily affected by water.

The preceding formulæ only carry us to the surface of the ground. Above the surface the ordinary rules for the strength of columns apply, and the pile may be regarded as a column having a pin bearing at the ground line and a square end bearing at the cap.

Driving Piles.—In driving piles a heavy ram with a short fall gives the best results. The fall should not be over 40 ft. and preferably much less. On my own road we drive to a 2-in. penetration under 20 ft. fall of a 2000 lb. ram. Clayey soils, especially where very wet or liable to become so, require a very large factor of safety. Elm and spruce are considered the best material, but in western practice oak and other timber are extensively used with good results.

In planning new work, it is often advisable to either make soundings or borings or drive test piles to determine the nature of the soil and calculate the necessary lengths to be used. Many additional formulæ will be found in Mr. HERING'S pamphlet covering this and other related points, to which all are referred for further data.

Increase in the Rolling Load.—The mathematical instinct would prompt one to calculate the exact sustaining power of the bent, and its probable maximum load, but in inspecting existing trestle work we rarely have any data showing the last penetration of the piles, and in construction it is useless to speculate too closely as to what rolling loads the future may bring forth. Not long ago the strains in bridges were computed with painful minuteness, but the recent drift of opinion is tending away from useless refinement in the computation of bridge strains. Bridge after bridge, all over the country, each carefully proportioned to strain sheets figured out with the most scrupulous exactness, has been replaced by a far heavier structure, because of a constant growth in the weight of motive power and rolling stock, which has been going on regularly for years past, and still the end is not yet. Not many years since we were talking of 1,500 lbs. rolling load, and later of 2,000, and then 2,240, while to day, our leading engineering journal is advocating for computation of strains in long spans, the use of a concentrated load of 50,000 lbs., followed by a rolling load of 3,500 lbs. per lin. ft.

Some idea, however, of the present and probable future loads can be derived from the following table, taken from the "Illustrated Album" of the Phœnix Bridge Company, which sufficiently indicates the heavy rolling stock now in vogue:

Road.	Type.	No. wheels or drivers.	Wheel base.	Total weight on wheel base.
			ft. ins.	lbs.
P. & R.	Coal Car	8	4 10	59,000
P. R. R.	Gondola Car	8	5 0	30 000
P. & R.	Passenger Car	8	5 4	30,000
P. & R.	Passenger Engine	4	7 0	68 000
P. R. R.	Passenger Engine	4	8 0	80,000
Cent. Vt.	Mogul Engine	6	16 6	94,000
P. R. R.	Pusher Engine	6	10 8	89,000
P. & R.	Consolidation Eng.	8	14 9	90,200
P. R. R.	" "	8	13 6	96,000
P. R. R.	" "	8	13 10	100,600

Shearing Stress.—In trestles of not over 16-ft. span, to which this paper is mainly confined, the bent probably receives its greatest stress when the second pair of drivers of a heavy Consolidation engine comes upon it. This stress, in bridge pariance, is termed the "shear," which for trestle bents is equal to the weight of the bent together with one span of the track and stringers, plus any load directly sustained by the bent, plus the shearing stresses coming respectively from the right and left hand trestle spans.

In Fig. 1 let A and C represent the caps of two trestle bents, and let LL', drawn to scale, represent any load sustained by the stringers. Then by the law of the

* A paper read before the Illinois Society of Engineers and Surveyors, by EDWIN A. HILL, of Indianapolis, Ind.

lever, the shear, or portion of the load sustained by C, is equal to $\frac{LL' \text{ in pounds} \times L\,A \text{ in inches}}{A\,C \text{ in inches.}}$ and if we take $LS = AC$ and join $L'S$, then CC' by scale equals the stress on C in pounds.

In Fig. 2, extending this principle, A, B and C are the caps of trestle bents and LL' and ll' respectively, the loads on the forward driving axle and pony truck axle of an engine; then since the load on the right hand ex-

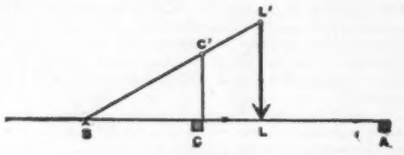


Fig. 1.

ceeds that on the left hand span, as the engine moves from right to left the shear on C coming from LL' will increase faster than that coming from ll' will diminish, hence the combined shear on the cap C will be greatest when LL', the greater load, arrives at its right hand edge.

Fig. 3 represents in magnitude and position the loads on the wheels of a typical Consolidation engine and tender [illegible] used by Prof. DuBois in "*Strains in Framed Structures.*" If now we conceive this system of loads substituted for the loads $L\,L'$ and ll' in Figure 2, then, as our Consolidation engine advances from right to left, the shearing stress on B will increase until the sum of the loads on the left span becomes equal to or greater than the sums of

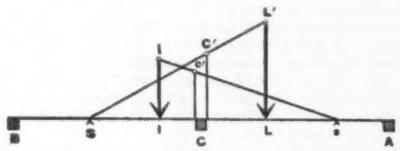


Fig. 2.

the loads on the right span, which occurs when load 3 is just over the left edge of the cap B, as shown in the figure. Should the engine now move farther to the left, we should have 66,000 lbs. on each span, and the shear on B would not be changed until load 4 passed off from the right hand span. We would now have 66,000 lbs. on each span, and a further movement to the left would not affect the shear until No. 1 passed off the left span, leaving a preponderance of weight on the right span, so that a further movement to the left would increase the shear on B until load 4 came over the right hand edge of B. These several positions of the load and span are shown in the figure by several drawings of the caps below the diagram of loads, and for convenience we suppose the trestle to be shifted from left to right under the engine, instead of the latter moving from left to right over the trestle.

In practice, however, the several positions giving the

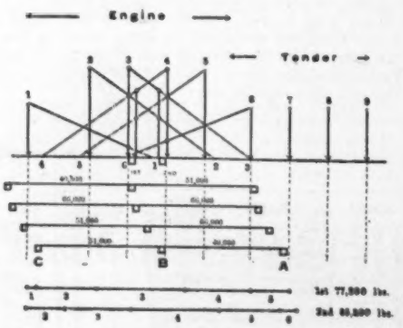


Fig. 3.

greatest shear on B are best found by drawing the two trestle spans with caps on a separate sheet of paper and sliding this along just below the diagram of loads.

The remaining construction is identical with that of Fig. 2. The cap B is drawn in the two positions giving the maximum shear and the several components of the shear in each case summed up on the two parallel lines at the bottom, from which we see that the second position of the load gives the greatest stress on the bent, corresponding to 83,500 lbs. Assuming track and stringers at 375 lbs. per lin. ft. and we have an additional weight of $375 \times 16 = 6{,}000$ lbs., or in all 89,500 lbs. stress on the bent.

There are already on some roads engines producing even greater stresses than this, so that in extreme cases from 90,000 to 100,000 lbs. on a trestle bent of 16-ft. span would not seem an excessive allowance, bearing in mind the tendency for engines and cars to constantly grow heavier. On the other hand, there are many roads where heavy Consolidation engines are not in use, nor likely to be introduced for some years—probably not until a projected trestle has been entirely replaced once, twice, or even more times.

We should not look farther ahead than the probable life of the structure we propose to build, or seven to ten years in the case of a wooden trestle; but in the case of a permanent iron structure, we must, of course, make a much more liberal use of extra material, striving to discount the future as far as possible, for once built it cannot be readily strengthened. With wooden structures it is different, but even then we should base our plans not exclusively on existing loads, but with a view to providing against probable increase in loads during most of the life of the structure. Hence for trestles we should increase present loads by a reasonable percentage to cover future contingencies.

Those familiar with the methods of graphic statics will have no trouble in computing both the shear for trestle bents, and the bending moment for track stringers. The methods suggested in this paper while analogous thereto, possess some novelty, but such as have better ones at command can of course employ them. As a general rule, we may state that *the stress on any bent is the product of the load into its distance from the other bent and divided by the clear span.*

In inspecting existing trestle work we should determine from the actual rolling stock in use the maximum shear on the bent, add the actual weight of one

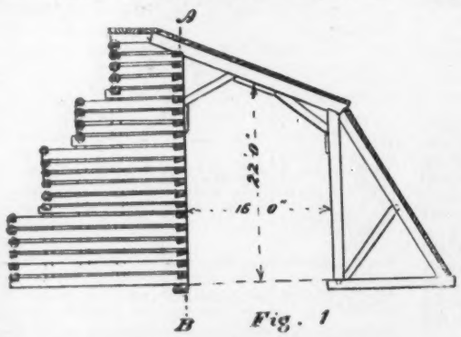


Fig. 1

Standard Snow-Sheds, Canadian Pacific Railway

full span of track and stringers, and divide by the number of piles, the result being the stress on each pile. Should this be less than 15,000 lbs. it is probably safe enough, unless the piles are unusually deficient in sustaining power; but the more this figure is exceeded the less confidence we should place in the structure, except we have some definite record of the actual performance of the piles when driven. In default of such information, it might be advisable in important cases to uncap a bent here and there, and observe the actual penetration of a few piles under one or two blows of the ram, and if we find this running pretty uniform we may apply the values of s, h and w in MASON'S formula, and by working out the value of f, the factor of safety, see how we stand.

Sway Braces.—Trestles are subject to lateral stresses owing to the side lurching of trains under high speed, and on curved trestles to centrifugal force; and also to longitudinal strains, owing to the tractive force exerted by the drivers of the engine.

The resistance of the track and stringers to buckling sideways partly opposes this latter force, and in pile trestles, unless of unusual height, the transverse strength of the piles also offers an efficient resistance.

The former strains are resisted mainly by the diagonal lateral bracing, consisting usually of two pieces of 3-in. plank one foot broad, spiked, or better still bolted by ¾ or 1-in. bolts, to the cap and to the piles at each intersection. Each additional pile in the bent, it will be observed, affords two more intersections for bolting, and, besides increasing the bearing value of the bent, renders it stiffer and better able to sustain the lateral thrust of the moving train.

Two and Three Pile Bents.—Two pile bents are quite deficient in sustaining power and lateral stiffness, even in bents spaced only 12 ft. between centers. Three pile bents, though better, have none too much stiffness and bearing value.

Four Pile Bents.—Four piles afford a bent with still more sustaining power, and one more efficiently braced against lateral stress, and this number is therefore to be preferred. Such bents spaced 16 ft. from center to center are used by many western roads, and while often deficient in bearing value where Consolidation, Mogul, or extra heavy four-wheeled locomotives are in use, answer very well for roads of medium traffic.

In the four pile bent the usual arrangement is either to have the track stringers bearing over or near the inner pair of piles, or else to ground two piles under each set of stringers; but piles cannot be driven exactly in line or at exactly equal distances apart. In practice they are driven as near to their proper position as possible, and then a cap sometimes 12 by 12 in. but better 14 by 14-in. because giving the stringer more end bearing and from 10 to 16 or more feet long is placed upon them.

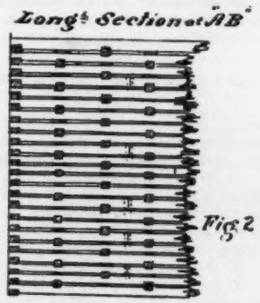
It was long the custom to secure the cap to the piles by mortise and tenon, drawing the cap down to its seats by a wooden pin, but modern practice avoids all cavities and crevices where water can collect and start decay, and we now usually find the piles sawed square off at top, and the cap secured to each pile by a drift bolt usually 1¼ ins. in diameter and long enough to drive about 8 ins. into the pile. Sometimes two smaller drift bolts are used instead.

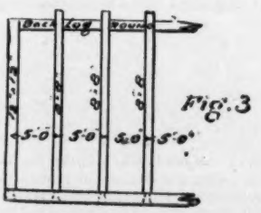
(TO BE CONTINUED.)

Standard Snow Sheds, Canadian Pacific Railway.

After spending much time and money to observe the principal snow slides in the Rockies, especially in the Selkirk Range, engineers having been detailed three winters for this purpose, and after drawing up a great many different designs, the one shown in Figs. 1, 2, 3, 4, was finally decided upon by the engineers of the Canadian Pacific Railway and many have been erected during the last summer.

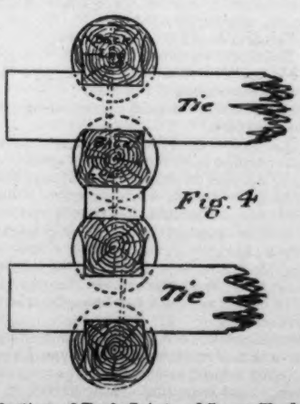
The sides consist, as shown, of solid walls of





12 × 12 in. timber, braced by rows of 8 × 8 in. ties spaced 5 ft. apart on centers. The back is built up of round logs, while the roof and unexposed sides are covered with 6 in. flagging.

The sheds are in all cases built in deep cuts, and



Section of Back Joints of Snow-Shed.

where the top of the cut does not reach the top of the shed, heavy embankments are made so that when the snow slides come down they strike the top of the cut or embankment and bound right over the sheds without subjecting the timbers to the slightest

stress whatever, so that, really, the only load that the wood work will have to support will be the dead weight of the snow, which often lies 20 ft. deep on the level in the Selkirk Range. Thus tons upon tons of snow and débris descending with an incredible velocity will pass over the track without stopping a train.

Radii of Worn Surfaces of Rails in Service.

The engravings which we publish of the radii of the worn surfaces of sixteen pairs of rails are from sections very carefully taken under the direction of Mr. THOS. RODD, Prin. Asst. Engr. of the Pennsylvania Co. with a view of shedding light on the question now under consideration by a Committee of the American Society of Civil Engineers, the proper radius for the corner of rails and the flange-fillets of wheels. It does not by any means follow that these radii should be the same in the beginning as they finally become by wear, but it is obvious that the two questions have a very intimate relation to each other. From these engravings the conclusion seems to be that the corner radius in service, both on straight lines and on the inside of curves becomes about ¼ in., with a short section back of the corner worn to a radius of ¾ in. to 1 in. On outside rails, on curves, the corner radius approaches much more closely to being the same as the fillet radius, or somewhat less than ½ in.

These sections are somewhat peculiar in the marked secondary radius, between the corner and the top of the rail. As a rule the top is much more nearly flat. We cannot now attempt to draw the proper moral from these diagrams, if indeed it is necessary to do so, but for the present leave every one to interpret them for themselves.

ADDITIONAL ERRATA in both first and second revised editions of "The Economic Theory of the Location of Railways." (In addition to the list given Oct. 1, 1887):

Page 554, par. 693, 2d line; strike out comma after "considered" which materially modifies the sense; making sentence read "or if only the load on the drivers be considered the engine, and the remainder a part of the train."

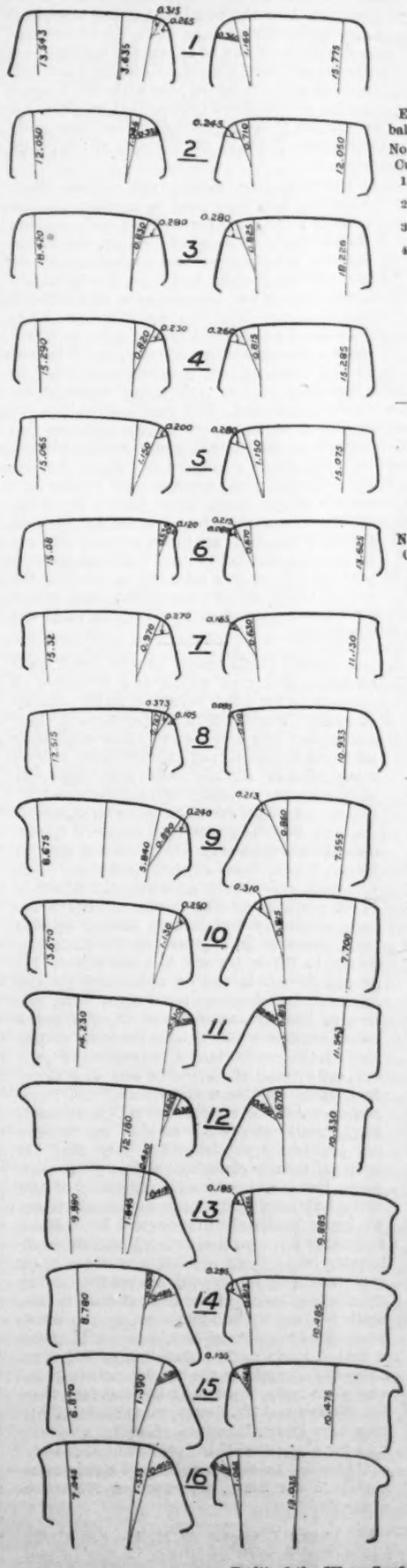
In the list of errata given in our issue of Oct. 1, page 883 should have read 833, page v should have read page 5, and the correction for page 286 should have read line 16, for .0082 *d D read* .00082 *d D*.

Page 741, 2d line; below Table 195; *for* 11.7 *read* ⅟.
" 901, par. 1272, line 7; *for* weights *read* heights.
" 386, 5th line of par. 470; *for* 0.0.25 *read* 0.025.
" 781, 8th line of par. 1052; *for* turning *read* burning.
" 757, Table 199, col. II.; *for* 61.1 *read* 6.1.

FROM a note published by the Bureau of Statistics in Berlin it appears that four-fifths of the engines now working in the world have been constructed during the last 25 years. The force, equivalent to the working steam engines, is in the United States 7,500,000 horse-power, in England 7,000,000 in Germany 4,500,000, in France 3,000,000 in Austria, 1,500,000. In these the motive power of the locomotives is not included, whose number in all the world amounts to 105,000, of which the United States has about one-fourth and represent a total of 3,000,000 horse-power. Adding this amount to the other figures, we obtain the total of 46,000,000 horse-power.

As a steam horse-power is equal to three actual horses' power, and a living horse is equal to seven men, the steam engines in the world to-day represent approximately the work of 1,000,000,000 men, or more than double the working population of the earth, whose total population amounts to 1,455,923,000 inhabitants.

A LATE copy of the *Illustrated London News* pictures the method of transporting the new Krupp gun, 45 ft. long, from Essen to Antwerp, there to be shipped to the Italian naval arsenal at Spezzia. The railway trucks carrying this gun are arranged practically as shown in our issue of April 30, 1887, for the transport of the Gruson armor-plates. The articulated truck is 75 ft. long, and is cut into four segments with 8 wheels under each, or 32 in all. The gun weighs 118 tons, and the carriage alone weighs 96 tons. This is equivalent to a load on the roadbed of at least 3 tons per lineal foot. It appears to travel anywhere easily enough over European bridges. We fear it would have a hard time getting far in America.



Radii of the Worn Surfaces of Rails in Service.

TANGENT RAILS—FAST SPEED.

Edgar Thompson Steel, 1876, 60 lbs. per yard, gravel ballast.

No. of Cut.	Corner Radii. Left.		Right.	
1	—	.265	1.16	.36
2	1.045	.355	0.71	.345
3	0.83	.230	0.82	.28
4	0.82	.33	0.815	.36
Average	0.900	.270	0.876	.386

TANGENT RAILS—SLOW SPEED.

Cambria Steel, 1875, 60 lbs. per yard, stone ballast.

No. of Cut.			Corner Radii. Left.		Right.	
	1875	Cambria	1.15	.30	1.15	.38
6	"	"	0.53	.12	0.67	.315 / .008
7	"	"	0.97	.27	0.63	.165
8	"	"	7.27	.37	0.51	.086
Average			.844	.240	.740	.211

FAST SPEED CURVE.

Penna.-W. Va. State line; 7° 20'; 6¼ in. elevation; stone ballast, Edgar Thompson Steel. 1880; 67 lbs. per yd.

	Outside.		Inside.	
9	0.86	0.213	0.24	0.80
10	0.915	0.310	0.25	1.13
11	0.815	0.405	0.30	0.51
12	0.670	0.490	0.31	0.70
Average.	0.815	0.355	0.275	0.81

SLOW SPEED CURVE.

6°; Wheeling Junction, 5¼ in. elevation; stone ballast, Edgar Thompson Steel, 1880; 67 lbs. per yd.

	Outside.		Inside.	
13	—	.418	0.185	0.555
14	0.630	.495	0.295	0.815
15	1.390	.380	0.125	0.405
16	1.555	.495	0.345	1.045
Average.	1.192	.434	0.242	0.670

ENGINEERING NEWS

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D. McN. STAUFFER. A. M. WELLINGTON. EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year; $2.50 for Six Months; $1.50 for Three Months; Single Copies,* 12 *cents.* FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

THE map which we present this week, constituting No. 3 of our series, will fortunately explain itself fairly well, by the aid of the full tabular records which appear on following pages. The pressure on our space this week is so great as to make it absolutely impossible for us to include the editorial summary which we had intended should appear. We cannot hope to entirely escape errors, and we hope that all our readers will scan the map carefully and advise us of any omissions or "commissions" detected; but we risk little in saying that it is far more correct than has ever been before compiled or that could be compiled elsewhere, especially as respects new projects and lines under construction. We take especial pains to draw the line carefully between mere wild-cat schemes and reasonably hopeful projects, and while the criterion can only be our own judgment, we think the conclusion is safe that most of the projects we map will go forward unless the financial outlook changes.

As we do not often ask favors of any kind of our subscribers, they will perhaps excuse us for suggesting that by extending the knowledge of this map series among railroad and financial men who are not now subscribers, they may be conferring a favor on both them and us.

THE nomination of Mr. JOHN BOGART, for so many years Secretary of the American Society of Civil Engineers, as State Engineer on the Democratic ticket, was one of almost ideal excellence, and we hope for the sake of the State that he will reconsider his declination, although we do not expect it, for it was no doubt strictly true, as he said, that he "could not afford it." Consequently, the million or so voters of New York will be deprived of the chance to express their valuable opinions as to whether Mr. BOGART or Mr. CORNELL is really the better man for the position.

Out of the whole body of voters there are perhaps four or five thousand whose opinions on this knotty point might conceivably be valuable, and four or five hundred which are really so. There is no more miserable bit of demagogism in our whole politics than the filling of such positions by popular vote and for two or three years only. The effect is not only that it is very hard to get competent men nominated, but that it is very hard to get them to accept when they are nominated. The salaries are not high enough to be tempting even if the position were for good behavior, but as the tenure of office has little or nothing to do with good behavior, but depends only on how the political breezes blow, it is rare indeed that any one whom the office would naturally seek can be induced to take it if it is thrown at him. We are not surprised that this should prove to be the case with Mr. BOGART, whose personal and professional qualities are such that probably no better candidate could have been found in the State, in either party.

Mr. ELNATHAN SWEET, the present State Engineer, has illustrated in another way the evils of mixing up such offices with politics. He has been an excellent officer, but we are credibly informed declined a renomination on the ground that he had held the office two terms, and it was now some one else' turn! It is but natural that this should be so. However good a nominee a man may be, he is apt to be something of a politician, and it is bred in the bones of our politicians to look on office holding as a "soft thing" to be impartially distributed. The real fact is, that the salary of almost every public office in this country is smaller than a man really qualified to fill it would command in private service. The dignity and permanency attached to certain of our offices alone tempts the many brilliant men in the public service to hold them. When these are taken away, as they are by popular election to minor offices, there is nothing left for any man to feel thankful for who is really fit for the place, and consequently no patronage to distribute except to unfit men.

THE State Engineership of New York commands a salary of $5,000, and if tenure of office were for good behavior, would readily draw men from $6,000 to $8,000 positions. It is a dignified and responsible office, especially now that the conduct of a State Survey may be attached to it. But the tenure is for two years only, with the necessity of treading on no political toes to get even one more term, and, it appears, a certain distorted etiquette forbidding the acceptance of a third term if it is offered. Under these circumstances the office will not tempt men to give up even $3,000 or $4,000 positions to take it, and the State has been extremely fortunate in getting so able and competent an engineer as Mr. ELNATHAN SWEET to fill it for the last two terms. He should by all means be nominated by the Democratic Committee for a third time, Mr. BOGART having declined, and if he is nominated, engineers throughout the State should see to it that he is elected, regardless of politics, for without intending in any way to reflect upon the Republican candidate, there can be no doubt whatever that Mr. SWEET is emphatically the better man of the two for the position, apart from the fact that his previous tenure gives him a just preference and a just claim. His administration of the office has been thoroughly non-partisan, for we know positively that several Republican assistants have been appointed without even inquiry as to their politics, any more than there would be for any private position. Our chief reason for speaking emphatically in this matter is an unwillingness to see the office prostituted to political uses, as we think there is real grounds to fear that it may be. The absurdity of making the office a political one was amusingly illustrated by the fact that Mr. BOGART and Mr. SWEET, who should of all men best know, found on glancing over the lists for a possible third candidate, that they could hardly recall the politics of a single engineer in the State, who seemed otherwise available.

Mr. FRANK L. GRISWOLD, M. Am. Soc. C. E., has started a very ambitious project in the Argentine Republic, which seems to have good prospect of success, and which is popularly known as the Griswold Railway. The project is now before Congress, but we do not know with what result. Mr. GRISWOLD proposes to make a railway "from Pergamino to Rio Cuarto, passing through Melincué and Vanado Tuerto, with two branches—the first from Melincué to Frayle Muerto, the second from Rio Cuarto to Cordoba." The whole system is the ordinary wide-guage of Buenos Ayres, 5½ ft., the length, cost and guarantee to be as follows:

	Miles.	*Cost.*	*Guarantee.*
		£	£
Main line	222	1,310,000	65,000
Cordoba branch.....	125	875,000	44,000
F. Muerto do.....	103	608,000	31,000
Total.....	450	2,793,000	140,000

The average cost of the railway is to be £6,000 per mile, and the concession is unaccompanied by any land-grant. It will, therefore, be the cheapest line constructed in the republic, and will open up all the pampas between Pergamino and the Sierras of Cordoba. A singular provision is that "the working expenses must not exceed 55 per cent. of the gross receipts," which many an American company would be glad to see effectually stipulated in its charter. The government's guarantee is 5 per cent. A local paper, conducted in the English interest, says:

"It appears to most people in Buenos Ayres unaccountable that the Central Argentine Railway did not throw out lines something in the manner now proposed by Mr. GRISWOLD, years ago. Had the shareholders and directors resided in this country, we feel no doubt that they would have done so. The Central Argentine, as its name indicated, was meant for a great trunk line, yet after 20 years of lucrative dividends, it is without a single branch. We have every expectation that before the close of the century (only 13 years) the Griswold Railway and the Sunchales line will, each of them, carry more cargo and passengers than the Central Argentine."

As the Central Argentine now earns over $11,000 per mile gross, this is a very favorable prediction.

WE devote a considerable space this week to the beginning of a paper of some length by Mr. EDWIN A. HILL on Railway Trestles. In so doing we must not be understood as endorsing many of the details of the paper, nor as assuming that the somewhat fine-spun mathematics are of importance for use in practical designing. Of all structures, put up by engineers, a wooden trestle should be the last one to proportion by mathematical rules. It is a rare case indeed in which a trestle is taken down before its timbers have *begun* to rot, and as there is no way of determining with certainty how far this rotting has progressed, and as its ravages are quite sure to be irregular in their distribution, as well as in their amount, a trestle must always be far stronger in the beginning than its breaking strength when new would require, and how much stronger must necessarily be more a matter of experience than of calculation.

Nevertheless, in this as in other matters, a full understanding of just what theory requires is a great aid to good practice, if it cannot be exactly called a guide, and for this reason we think all engineers will be profited by reading this paper, if only to refresh their memory. Certain of the practical details of Mr. HILL's paper we should be compelled to question or dissent from, but we refrain from fuller comment on them until the whole paper has appeared.

THE important action at the last meeting of the American Society of Civil Engineers, which we report in full elsewhere, comes too late in the week for us to even attempt a discussion, but we congratulate the Society on the excellent prospect that its strength and usefulness will be greatly increased, both by

abolishing the danger (which has many times proved a real one) of black-balling from unworthy or inadequate motives, and by providing an acceptable place in the Society for engineers of every grade of experience far more completely than ever before, by slight changes not affecting in any sense the real nature of the Society which we are confident will commend themselves to all but universal acceptance. Whether the new lower grade which it is proposed to create be called Junior or Student is a minor matter. The thing and not the name is the important point, and while the name Junior as now used is a most unfortunate one, we are not at all sure but that it will be the preferable one for the new grade, which will be made up of much younger men.

THE Aldermen of this city are at last taking some interest in the present and past horrible condition of our streets, and especially with reference to the misuse of rights and privileges by the Steam-Heating Co. An effort was made to test the power of the City in collecting some part of the $50,000 bond given by the steam company to insure the proper maintenance and repair of streets interfered with by them. And a further effort was made to discover just what control the Aldermen have over the streets, and whether new and more stringent ordinances are necessary. But the whole subject has been referred to the Committee of Street Pavements for discussion. In this connection Mayor HEWITT answered a complaint from the Construction Co. that the leaking steam was liable to injure the conduits at Broadway and Ann streets, by stating that—the Steam-Heating Co. had done more damage to the streets of the city than any other corporation. It had committed innumerable outrages on a long-suffering people, and he intended to go before the Grand Jury and have the officers indicted. But to the suggestion that the streets be put under the control of the Board of Electrical Control, the Mayor replied that—"The one is as bad as the other." The fact is that just now these two companies seem to own our streets between them somehow. Which one of the two will assert its rights of ownership for the longest time is a question yet to be decided, but we think it would be safe to bet on the steam company. As far as the comfort of the public is concerned, it is a serious question whether the system of the American Steam Co., which blew itself out of existence in a few months, was not after all somewhat better than a plant that is failing in a less demonstrative manner, but is continually at it.

WE find the following new and terrible evidence of the evils of protection in an English journal. Comment is superfluous:

"The returns of 1886-7 in the United States show that the annual value of houses, etc., built is much more per inhabitant than in Europe: viz.—

		Per inhab.
New York	$85,300,000	$64
Philadelphia	45,000,000	45
Brooklyn	19,800,000	30
Chicago	19,100,000	32
Kansas City	8,200,000	90
St. Louis	8,800,000	24
Minneapolis	7,100,000	60
San Francisco	4,200,000	15
8 cities	198,100,000	45

"This is an average of £9 sterling per inhabitant, and we may fairly assume that the general building of the United States is at least £3 per head, which signifies an increase of wealth equal to 180 millions sterling per annum. During 10 years ending 1880 the accumulation of the United States averaged 240 millions sterling per annum, or a trifle under £6 per head. It would seem, therefore, that JONATHAN puts half his savings into bricks, mortar, etc. The value of house property in 1880 was 2,780 millions sterling, say £56 per head, and the annual increase is now equal to 6 per cent., doubling in 12 years, whereas population only doubles in 24 years.

"So enormous an increase in house-building is due partly to the increasing industry and wealth of the United States, partly to the unfortunate Protection system which renders it difficult for Americans to invest their capital in foreign commerce. The American flag, which in 1840 disputed with Great Britain the mastery of the seas, is now only to be seen at long intervals and in unfrequented routes."

Brakes and Brake Gear.

More complete details of the late Burlington brake tests do still more to heighten the interest of the record. Despite the remarkable efficiency, which was so high that it may be said to leave no room for further progress, except to assure as high a rate in practice, the air and brake pressures were very low, less than two thirds of the insistent weight, so that so far as known not a single wheel was skidded. Experiment seems to indicate, in fact, that the same law holds with brake-shoes as with lubricated surfaces, that the *coefficient* of friction is far lower with high pressures, so that the gain by increasing pressure is very small. Modern experiments furnish cumulative evidence that this is a universal law of friction. In the BEAUCHAMP TOWER experiments, with finely lubricated surfaces, this variation of coefficient went so far that Mr. TOWER said it almost seemed, at times, as if the total friction were a constant quantity, regardless of the pressure. It is extremely probable that something like the same law holds with brake shoes, and it is greatly to be hoped that the WESTINGHOUSE company, or some railway, will make some experiments to determine just what the laws of brake friction are. At present the only definite information which exists as to these laws is that derived from the GALTON-WESTINGHOUSE tests of 1878, and these shed little or no light on the variation of the coefficient with pressure, although they did shed a great deal of quite unexpected light on its variation with speed and with time of application. These tests were not so extensive, however, but that their details need confirmation even in this latter respect, and they did not include at all the chilled cast-iron wheels which so heavily predominate in this country. Further tests, therefore, should certainly be made.

The important practical results which may flow from such "theoretical" work was never better illustrated than by the Burlington brake tests themselves, which first revealed an unexpected difficulty—the danger of shock—and have now, at last, shown that it can be cured completely, without what seemed at first the only remedy, electric application. The same tests have led to what seems a perfect cure for a former difficulty of the WESTINGHOUSE apparatus, graduating the speed down hill. A vast improvement was shown in the later tests in this respect, which is a very important one. Whether the improvement is so great as to make it possible to dispense with the pressure-retaining valves which are now so largely used on long heavy grades in Colorado and elsewhere, we are not informed. We should imagine not; but it is a great thing to have the brakes so much better adapted to the ordinary up and down work of ordinary lines.

However well a brake may show up in tests, however, it cannot be expected to show up well in service unless there is something like as great care taken to develop the maximum efficiency of which it is capable, as there is in tests, and we take it to be beyond question that if a dozen or more of our leading passenger trains could be caught on the fly, so to speak, and put through a course of tests, the stops which they would be able to make would almost without exception be discreditably slow. This would result from several causes, first, the brake-gear would be considerably off from perfect order; secondly, the brake-leverage would very frequently be found to have been cut down below all reasonable limit with a view to save all danger of sliding wheels (this is especially common with parlor and sleeping cars) and thirdly, the bulk of all our fast trains consists of 12-wheel cars, and the 6-wheel trucks, without exception, have brakes on four wheels only. Thus one-third of the weight is left without any brakes whatever, and practically, the braking power would be more nearly doubled than increased 50 per cent. by putting shoes on each side of the middle wheels, as would most likely be done if brakes were applied to them at all. The enormous increase in the number of 6-wheel trucks is making this a question of great moment, and it is one of the few questions of the kind on which a little mandatory legislation would be eminently wise, and is in no great danger of being so badly framed as to prove particularly unwise. Allowing a reasonable time for the change, no car should be allowed to run in either a passenger or freight train (after the latter have train brakes) without having efficient brakes acting on every wheel. It would save many a life every year were this done, while the expense of doing so would be but trifling. We have understood that Mr. WESTINGHOUSE is giving some attention to the design of a brake-gear for 6-wheel trucks, and the difficulties should not be great, although the space will be found rather contracted. But we fear it may take a long time to bring any such apparatus into use, unless it is aided a little by the law.

Noise on Elevated Railways.

WHEN our New York elevated lines were first being opened there was an immense amount of (apparently) very active investigation to find out what could be done to remedy the noise. The resulting conclusion—which perhaps was reached earlier in the investigation than the public supposed—was that there could nothing be done, and nothing was done. Of late a very great and marked improvement has been effected by the introduction of the Fisher joint, which is now being quite rapidly applied, and before long, no doubt, will be the only joint in use. But not one of the various nostrums, poultices and packings which were proposed was able to establish itself as worthy of adoption.

In the erection of the new Berlin elevated railway the suppression of noise was a prime object in the design. To this end wherever possible the viaduct was built of brick or stone masonry; but as it is inexpedient to cross crowded streets with structures of this class, iron superstructure was utilized at these points. The rattling of these metallic trusses caused loud complaint on the part of the residents, and the German engineers have been conducting a series of careful experiments with a view to diminish the noise if possible. They find that the form of truss has little effect upon the noise and that a lattice truss makes no more noise than a plate girder. But the length is discovered to be an important factor, and the engineers now consider that the sound is in direct proportion to this length. Where the rails rest on wooden cross-ties, or on timbers running longitudinally the noise is less than when they are secured directly to the metal work, and the noise is still further diminished by the use of felt or rubber cushions under the timbers. Planking over the entire bridge has little effect unless this planking is covered with gravel, a thin layer of which has a decidedly deadening effect. And this effect is still more marked when the cross-ties and longitudinal timbers are buried in the gravel.

As a result of these experiments the German engineers have adopted two expedients for the suppression of noise on their elevated structures. The first plan is to bolt to the bridge-structure long troughs of sheet-iron, about 16 in. wide, and in the center of this trough is placed the longitudinal timber carrying the rail, and the trough is then filled

with gravel, completely burying the timber. A more efficient plan consists in covering the line of track with a continuous series of shallow iron pans, about 5 ft. square and filling them with gravel, and upon these the ties and rails are laid and imbedded.

Every one living in the neighborhood of a New York elevated structure would doubtless most heartily approve of any changes in our own roadbed having a similar object in view. Like the proverbial eel, we get used to it in time, but the noise is a nuisance of colossal dimensions all the same and under all circumstances. We would hesitate somewhat to recommend any further loading of our superstructure, even with gravel-pans, unless the trusses were strengthened in proportion, as our ample and very useful heavy guard timbers would require a considerable additional volume of gravel to make the remedy really efficient. Just what could be done in the way of cushions in checking the vibration and deadening the sound we know not, as we have no knowledge of any long conducted and careful experiments in this direction other than those made in Berlin.

But the best plan of all, and the one that in the end would probably be the most economical, both in the life of the structure, in greatly decreased cost of maintenance and in suppression of the noise, would be the Berlin plan of masonry substructure. It is too late now to think of changing existing structures in this city to stone or brick work, as the latter cannot of course be allowed in our streets, and there is considerable doubt whether metallic work has any business there. But we do hope to see one of two things done in the elevated railway of the future, either make them of long metallic spans lifted high above the buildings, and crossing and traversing the city by the most direct lines; or, if they are to stick to the surface, let them cut through the center of the blocks, with the roadbed resting upon archways of solid masonry sufficiently strong to carry a two storied double-track railway, if necessary, and a roadbed of sufficient mass to absorb much of the objectionable noise. This is an expensive plan, but it is pretty well understood that any elevated structure that may now be built in this city must cost much more money than those in use. This will be necessary, both from the extent of the service demanded, and for a reduction in the constant tinkering, strengthening and care which the present roads require, built as they were without the slighest idea of ever reaching half their present traffic.

Aside from the fact that a line cutting through the blocks would leave the parallel streets unobstructed, as they should be, the archway under the track could be made parallel with the axis of the road, at some expense of masonry, and another thoroughfare thus provided between parallel streets, a gain much to be desired in many parts of New York. Whether or not this archway could be utilized as an "arcade" for business purposes, without interfering with the solidity of the main structure, is a subject well worth considering when the question of increased value of adjoining real-estate is to be discussed. If an additional double line of shops can be provided, even if they must be lighted artificially, tenants could doubtless be found, and the adjoining property be rendered more valuable either to the company or to original owners. The enormous first cost of real-estate is the great stumbling block in the way of this center-block system, and any means of lessening this cost; or—what amounts to the same thing—of increasing the value of abutting property, must hasten the day for such a structure in New York.

The street-crossing of the ideal elevated railway should also be heavy enough to carry its full quota of ballast, though the structure itself would most likely be metallic, with posts on the curbs alone, if a shorter span than that from house-line to house-line was considered necessary. We frankly admit that we do not expect to see this elevated, center-block road built at once in New York; but we do believe that the time will come when New York will see the folly of handing over its streets gratuitously to railway companies, and when the traffic will be so enormous that even the maximum outlay in first cost will be warranted by the business "in sight." Once built, such a road should be much safer to the public and occasion less worry to its owners, and it would have a life-time very far exceeding that of any wholly metallic structure. Such a road should cost less than a tunnel of like capacity, and while serving an equal purpose, would have great advantages in sunlight and ventilation.

The Government and Public Works.

The relation of the various departments of the United States Government to the public works of all kinds executed under these departments is in itself a curious study, and the mixed conditions of control which have gradually come about can only be explained by the somewhat vague laws which seem to regulate the growth of a nation in its rise from a very small beginning to a position of great importance in the world. In other words to explain the present status the entire life of the nation must be studied.

In the last number of *Lippincott's*, Prof. L. M. HAUPT, who has previously done good work in this direction, advocates a thorough reorganization of the various departments of the Government and discusses the means which will be most likely to produce economic results. As showing the evils of the present system of conducting the civil public works of this country, the author copies the following exhibit from the admirable paper by Gen. W. F. SMITH, which we published in our issue of June 11. The chief technical departments of our Government are:

1. *The Improvement of Rivers and Harbors*, which, by precedent only, is in the hands of the Secretary of War, and carried on by the Engineer Corps of the Army.
2. *The Coast and Geodetic Survey*, under a bureau attached to the Treasury Department.
3. *The Geological Survey*, under the Interior Department.
4. *The Survey of Public Lands*, under the Interior Department.
5. *Public Buildings*, including court-houses, post-offices, mints, monuments, State and departmental offices, etc., mostly under the control of the Treasury Department.
6. *The Meteorological or Weather Bureau*, in the hands of the War Department, because the idea of collecting and uttering the data originated in the brain of a clever army officer, who organized the Signal Service of the army and became head of a bureau for its administration.
7. *The Agricultural Bureau*, belonging to the Department of the Interior.
8. *The Bureau for the Administration of the Light-House System*, which is an appendage to the Treasury Department.
9. *The National Observatory*, which, with its varied duties, is assigned to the Navy Department,—a disposition which could hardly be explained without going into the history of the passage of the law creating the bureau.
10. *The Bureau of Patents*, one of the largest and most important of the administrative bureaus of the government. This is under the Interior Department.
11. *The Inspection of Hulls and Boilers of Steamers*, under laws and regulations for the protection and preservation of life and property afloat,—a branch controlled by the Treasury Department.
12. *The Bureau of Pisciculture.*

This shows a very confusing mixture of control, and just why one class of surveys is delegated to the Treasury, another to the Interior, another to the War, and still a fourth to the Navy Department, is a conundrum that, with Gen. SMITH and Prof. HAUPT, we must give up. The principles underlying all are the same, and the entire work could be far more economically performed under one head. The whole present system, as before mentioned, is the result of chance or accident as notably in entrusting the purely civil work of opening up rivers and harbors for the uses of commerce to officers whose principal training is of a military and not of a civil character.

The author of the article referred to strikes the key-note of the difficulty in the proposed co-ordination and systematizing of these bureaus, in the ever-present spirit of conservatism and the loss of a certain amount of political patronage on the part of those who alone can make a change for the better. He thinks this difficulty more imaginary than real, and we agree with him, if a majority of our statesmen would consider that their obligations are not to their district alone but to the whole country, and that they should legislate for the general good, knowing that the greater includes the less. Unfortunately for us this has not proved to be the case so far, if the vigorous log-rolling of each session for some measure of infinitesimal or no importance at all, saving in its local effect on the personal chances of the representative, can be taken as an index of the methods of our legislators.

There is no doubt of the advantages of the proposed reorganization under a Public Works Department, as briefly pointed out in our issue of June 11. With the same money appropriated, to be expended upon the same class of works, under the same administration, and in the same districts virtually, we could avoid waste of time, danger of failure and local jealousies and contests over items, by removing the present objectionable methods of legislation. If the change were once made, the relation of the representative to his constituents would be really rendered much smoother than at present, as he would be relieved from the responsibility of obtaining his *pro rata* of an appropriation regardless of the honest needs of his district. Instead of the manner and place of spending a certain amount of money being almost purely a personal matter, as it is now, he could refer his clamorous voters to some head of a distinct bureau for satisfaction; and as this bureau would have the national, and not local, interests in view, and be under no direct obligations of any character to the claimants for favors, the subject would be more likely to be decided upon its general merits alone. Under such conditions we would hear less of the appropriation of thousands of dollars for the improvements of creeks which were even unknown by name to the U. S. Engineer officers in charge of the district which was supposed to contain them, as happened less than two years ago in North Carolina.

Space forbids our entering into the detail presented by Prof. HAUPT in an analysis of the methods of the War Department in relation to the improvement of rivers and harbors, which is taken by the author as an example of the abnormal chance development of a bureau to meet the exigencies of public requirement. Nor can we give in detail his contrasting exhibit of the civil studies pursued by the military engineers of the country and by the graduates of institutions devoted to *civil* engineering. The first question is one merely of ancient history; and as respects the educational question, in our opinion, it is not so much one of the qualifications of the personnel as it is one of a proper head. But we do believe with the author that, with a reorganization of bureaus once accomplished, the true remedy lies in the direction of perman-

ency of residence, individual responsibility for results, adequacy and certainty of appropriations and a system of promotion based upon relative ability and not upon military succession. As outlined by Prof. HAUPT, these results can be obtained by dividing the country into topographical basins and assigning to each a Chief Engineer, whose tenure of office shall be for life, subject to removal only for incompetence or misdemeanor. The first appointments should be made by the President from nominations made by the Chief of Engineers and the various engineering societies of the country, and subsequent appointments should be by promotion, under the civil service rules, from among the junior engineers of that residency. The chiefs of these districts should compose a board to estimate and recommend the amount of money required to continue improvements in their districts and to frame a bill for the total amount to be submitted to Congress; or the total amount required to complete any projected work may be submitted and appropriated, payable in annual installments by the Secretary of the Treasury.

Whether or not this is the best plan possible for an improvement on existing conditions, we are not prepared to say. But it would be a most desirable improvement upon the present practice, both from an economic standpoint and in the interest of civil engineers. This is one of the few cases in this country where a life tenure of office, limited by sharp rules regarding honesty and efficiency, would have great advantages, as it takes years of study to fully and properly appreciate and understand the physical, mechanical, commercial and social requirements of any one district. Permanency of position, promotion in due course and the sense of being held individually responsible for the work to be done, are all elements essential to true economy, and the obtaining of the best engineering results. And as these elements are all lacking in the present control of our civil public works, we can only hope, with the author, for an early and careful consideration of this subject by Congress. It is a matter that has been too long delayed.

The permanent remedy for the undoubted evils and injustices of our present helter-skelter system lies probably in the organization of a Department of Public Works, in which military officers as such shall have no more influence and no higher positions than their technical acquirements give them. Until wars and rumors of wars cease altogether there must always be a corps of military engineers to which the country will look for our defence, and there will be full employment for a very considerable corps of such men, but the present plan of turning over to this corps our works of peace likewise, works evil and injustice in several ways. In the first place, it makes the bulk of our corps of engineers more civil than military officers. There are many of them whose experience has been almost solely in civil works. In the second place it cuts off the young military officers from the best possible training for their profession, long discharge of the practical duties of subordinates, since a heavy force of civil employés now discharge these duties, and it is not etiquette for any military officer, however young and green, to be subordinated to any of these civil officers, however able and experienced. In the third place, it cuts off the chance for healthy growth at its fountain head, by absolutely excluding the young men who are having the best of all training for advancement, long experience as subordinates, from all chance of obtaining it. The high character of the Corps of Engineers has alone prevented great trouble from resulting from this unnatural arrangement, but it is unnatural, and demands a remedy.

Blasting Without Tamping.

THE effect of a clay-plug in a drill-hole instead of the ordinary hard tamping, as noted by Mr. CHALON elsewhere in this issue, may not be new to some of our readers. But the simplicity and apparent efficiency of his method is so great that we would like to hear from some of our own miners upon the subject. We give the results as stated by the author, without knowing anything more about the character of the rock experimented upon or other controlling conditions, but his reasoning seems to have the support of other outside testimony. Probably few of our readers would care to try the experiment of firing an ordinary shot-gun with the wad jammed half way down the barrel; for nearly everyone knows that a "busted" gun would probably be the result. Yet this is practically what Mr. CHALON does in firing his mining charge, and it is just that increased rending effect and decreased power of projection that is so effective in this case.

With high explosives this plan would probably have little or no increased effect, as the liberation of the gas is instantaneous and at once exerts its full power upon the sides of the bore-hole; in fact with high explosives water is one of the most efficient materials for tamping known or used. But with black powder the gas is liberated gradually, in comparison, and it is undoubtly true that much of the powder is projected from the hole unburned, or under conditions that represent a decided loss as far as the rending of the rock is concerned. This throwing away of unburned powder has long been noted in the case of artillery firing where projection and not rending is the end aimed at, and where this air-space above the powder charge would be very dangerous, as before noted.

There may be some virtue too in the yielding character of the clay-plug as compared with the firm sides of the hole, or solid tamping, when using gun-powder. Thus Gen. HENRY L. ABBOT, U. S. Engineers, found that nitro-glycerine fired under water was less effective than dynamite No. 1. And he explains this circumstance by the statement that as water is of a slightly yielding nature, a certain time is required to overcome this resistance so that the more powerful explosive, acting too suddenly, is less effective. So then the value of the air-space over the powder charge, (which it seems to us is the chief cause of the increased effect by permitting complete combustion in a slow burning powder), may be added to by the time necessary to overcome the yielding character of the clay before the plug can be blown out and the gases escape in that direction. This theory would seem to be supported by the statement of Mr. CHALON that a plug of wood inserted in the clay was projected to a comparatively short distance from the mouth of the drill-hole, showing that the effective work of the powder was practically expended in rending the sides of the bore-hole before the clay had yielded sufficiently to be thrown out.

To quarrymen and users of black powder the subject is well worthy of careful testing, especially as it is so very simple in its application.

Report of Lieut.-Col. Walter McFarland on Work About New York.

Lieut.-Col. WALTER MCFARLAND, U.S. Engineers, has just submitted his annual report upon the improvement of New York harbor. He says that the deepening of Gedney's Channel will probably be finished this year; 700,000 cu. yds. of material will be removed from this channel. The work of taking 150,000 cu. yds. from the main ship-channel will then be commenced, and is to be finished by Dec. 1, 1888. This will only be one-half the amount that must be removed to secure 30 ft. depth of channel at low-water with a width of 1,000 ft.; to remove the remainder will cost $540,000. Col. MCFARLAND earnestly protests against the injury done to the harbor by the dumping of dredgings, cinders, etc. During the last fiscal year, $152,372 were expended upon Gedney's Channel, and $540,000 can be profitably expended during the next fiscal year upon the harbor improvements.

At Hell Gate the appropriation of 1886, $112,500, was too small to admit of working the drill-scows on the small reefs and on Flood Rock at the same time, so the amount was applied at the latter place in increasing the width of the new middle channel. In the fiscal year 34,956 tons of rock were here removed, leaving 230,000 tons yet to be removed. A cut has been made on the Flood Rock side of the new middle channel from 30 to 50 ft. wide and of an average depth of 21 ft. During the next fiscal year $500,000 can be profitably applied entirely to the removal of Flood Rock and drill-scow work on other reefs. This is desirable because of the extensive plant on hand and the fact that there is but one drilling company in the United States that has dredges that can do the work at Flood Rock, and as there is therefore no competition, reasonable bids can only be secured by an appropriation sufficiently large to make it possible to reject unreasonable bids and to purchase the machinery to do the work by day labor.

In connection with the Harlem river improvement, a complete system of borings is now being made, and though this is not completed the existence has been proven of a bed of semi-fluid mud, from 60 to 100 ft. deep, on the line of the proposed cut south of Johnson's foundry on Spuyten Duyvil Creek. The $400,000 available will be applied to beginning work on the rock-cut through Dyckman's meadow. This is not more than half enough to begin this work and $1,000,000 can be profitably expended there next year.

Of the Gowanus Bay improvements the report says the dimensions of the originally proposed channels are too small to meet the great increase in length and draught of sea-going vessels. The depth should be 21 ft. at low-water and the width 400 ft., this change of plan would cost $403,500, while to complete on the old plans would cost $120,000. For the Hudson river improvement $255,000 can be expended in completing it in the next year. For Newtown Creek only $37,500 was appropriated in 1886, but the commerce is so large that the work should be extended at least 3 miles from the mouth as soon as possible. It is recommended that $100,000 be appropriated for continuing the improvement. For removing the shoal jutting out from Red Hook Point on the Brooklyn side of Buttermilk Channel $56,250 was appropriated in 1886. To complete the existing project $95,000 is asked for in the next fiscal year. The $37,500 set aside for work on Raritan Bay in 1886 is not yet expended. An additional appropriation of $76,500 is recommended during the next fiscal year for deepening the South Amboy channel from Great Beds Light, etc.

The Effect of not Tamping Drill Holes.

P. F. CHALON, in the last issue of *Le Genie Civil* gives the results of some experiments in abolishing tamping in drill-holes and the gain in rending effect resulting. He says he was led to these experiments by witnessing some tests of a new cap invented by M. SCOLA, in which the hole was simply closed by a wooden plug about 7 ins. long. The plug was not tight and permitted a considerable escape of gas, and a portion of the useful effect of the powder was expended in projecting the plug to a considerable distance.

The idea then occurred to him of simply plugging the hole with a handful of wet clay, which in a manner would hermetically seal it, and the resulting effect of the explosion "was enormous." He repeated the experiments a number of times and found that the dislocating effect of the black powder used under these conditions was much greater than when ordinary tamping was employed. A hole 6½ ft. deep was charged with about 2 lbs. of gunpowder and the hole closed with a clay plug about 5 ins. long. The lines of least resistance in the rock measured 5.9 and 7.2 ft. The mass removed by the explosion equalled 27 cu. yds., or about "13½ cu. yds. per pound of pow

der." (21 cu. m. per kilogramme of powder). In a second experiment with a hole 4.26 ft. deep, 1.3 lbs. of powder and a line of least resistance of 5.6 ft., there was no projection of the rock but simply dislocation, that is, the best utilization of the explosive. The volume loosened equalled 16.67 cu. yds., or about 12.7 cu. yds. per pound of explosive. A third experiment with 2.6 lbs. of powder gave an effect of nearly 12 cu. yds. per pound of powder. The mean of five experiments, including two charges fired simultaneously, was about 13. cu. yds. per pound of powder used.

Under ordinary conditions of firing in the same quarry 7.5 cu. yds. per pound of powder was the result. Thus the new tamping, even at the low average figure of 9 cu. yds. per pound of powder, amounts to a decided increase in effective result. The same results would probably follow from the use of any other substance than clay for hermetically sealing the mouth of the drill-hole, says Mr. CHALON.

The author says further, in explaining these remarkable results, that the explosion under mining conditions always produces three distinct effects.

1. The breaking of the base of the hole.
2. The dislocation of the sides.
3. Projection.

Each of these effects is more or less marked, according to conditions, and one may exceed in effect at the expense of the other two. The work of breaking is difficult to calculate, but Mr. CHALON thinks it is not less than 15 per cent. of the total work. The work of projection of powder, in firearms, is about 14 per cent., and we can suppose that it is about the same for powder used in mining. The effect of projection is manifested in a special manner sometimes in mining, as when the explosion results in "a gun," to use a mining expression; that is, when the work is expended in blowing out the powder or in slightly enlarging the diameter of the bore-hole without breaking the rock. Generally the effect of projection is to displace the broken rock and throw it to a greater or less distance from the site of the explosion. This is practically work entirely lost, and equals about 30 per cent. of the total work when the breakage is included.

On the other hand when the charge is compressed under hard tamping and reduced in its normal volume, the powder has not time to burn completely and a good part of it is dispersed without useful effect upon the rock. With mining powder in grains, the author estimates that 20 per cent. in weight of the powder is thus wasted. Thus in each kilogramme, or 1000 grammes, of powder, only 800 grammes do any effective work; and as the power lost in breaking and projecting equals 30 per cent. of the total work, there remains as utilized only $800 \times 70 = 56$ per cent. That is, the useful effect of a kilogramme of powder, under tamping, represents not more than 56 per cent. of the total theoretical work.

In now considering the case where the tamping is omitted, we have an air-chamber superimposed above the charge, permitting the powder to become thoroughly ignited and the gas developed to expand regularly and manifest its power throughout the whole extent of the sides. And the force of projection is also diminished, as can be proven by the relatively short distance to which a wooden plug embedded in the clay would be thrown. The loss from unburned powder is less, as shown by the light smoke and the disappearance of this immediately after the explosion. Taking the figures first given it will be seen that without tamping, the useful effect of the explosive is about 76 per cent. in place of 56 per cent. of the total theoretical work.

Mr. CHALON sums up the advantages of the omission of hard tamping as follows:

1. Economy in hand-labor.
2. Economy in material as the powder is utilized better.
3. Better rending effect.
4. The suppression of the accidents so often resulting from tamping.

In his experiments the charge was placed at the bottom of the hole under the usual conditions, connected with a fuze or electric conductors, and the mouth of the drill hole was then sealed by a clay plug 5 or 6 ins. long. It is essential that this plug is fitted tightly, leaving no fissures for the escape of gas before combustion is complete. In place of clay, cement or plaster of Paris might be used.

CORRESPONDENCE.

The New Method of Dimensioning.

EDITOR ENGINEERING NEWS:

In the remarks upon this subject, in your issue of Sept. 3, Prof. CAIN states that formula (1) is "intended solely for the chords and ties of a bridge." Now this makes a very satisfactory and important distinction between the object of this formula and that of formula (*A*), for the latter formula is intended to apply to every part of a railroad bridge affected by the dead and rolling loads. Not only therefore is formula (*A*) intended for the chords, ties and posts of a bridge, but it is also intended for floor-beam hangers, end vertical suspenders, floor-beams and stringers.

Where formula (1) is adopted, the old arbitrary unit stresses must be used for the above and following exceptional cases, but by the adoption of formula (*A*) these cases fall into line, and the unit stresses in the various members of a railroad bridge can be found by the application of a single formula.

As the terms "chords" and "ties" are not applied to web plate girders, it is presumed that formula (1) is also not intended for web plate girder bridges. Formula (*A*) is intended to apply to these cases also; so that it will be seen that this formula is intended to cover a much wider field than formula (1), and upon this distinction I am willing to let the relative merits of the two formulæ stand.

A. D. OTTEWELL.

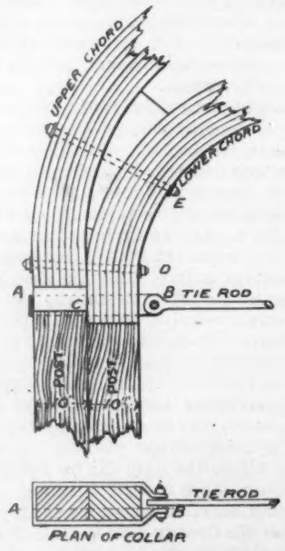
A Cure for a Bad Roof Truss.

149 *Broadway*, NEW YORK, Sept. 21, 1887.

EDITOR ENGINEERING NEWS:

The following peculiar condition of a roof truss, and the novel method of overcoming the difficulty may be of interest:

We were called upon to inspect a building and



Cure for a Bad Roof Truss.

suggest temporary repairs. The roof trusses were of the bow-string type, not particularly well proportioned or constructed. A settlement of the truss at the center and a bulging at the haunches, together with the end of the upper chord having been cut a little short, had tended to draw the foot of the upper chord out from the collar or yoke of the main tie rod at *A*, as shown in the accompanying sketch.

Fortunately, the shoulder at *C* and the bolts *D* and *E*, prevented the whole truss kicking outwards to the destruction of the building, but danger still existed, as the collar had only a slight hold on the post, and might work up, and slip through *C*, a distance of 10 ins.

The foot of the trusses was everywhere very inaccessible, but it was possible to get at them sufficiently to fill the space *C* with a mixture of iron filings and salammoniac, well rammed into place, forming a solid block of iron cement, thus giving a full bearing for the collar and truss, without the difficulty of taking out the walls of the building and the risk of disturbing the trusses. C. B.

Pile Driving by Electricity.

HOUSTON, Tex., Sept. 20, 1887.

EDITOR ENGINEERING NEWS:

Referring to the communication of B. H. in ENGINEERING NEWS of Sept. 17, in which he suggests the employment of electricity in pile driving, it may be of interest to state that some six or eight years ago piles were actually driven by electricity, although not in the way that he suggests,—on the estate of the Marquis of Salisbury, in England. Although the fact was referred to in ENGINEERING NEWS of that date, I do not recollect having ever seen in print a description of the method employed. The pile driver was of the ordinary hammer and fall type, but the drum, instead of being operated by steam power was run by a dynamo which was geared to it. The current to run this dynamo was furnished by another dynamo situated at some distance from the driver, and connected with it by a suitable conducting wire. The last mentioned dynamo was run by water power furnished by a convenient stream through the medium, if I recollect rightly, of a turbine. All the conditions were such in this case that the work was done very economically as well as effectively. In a letter which I possess (but unfortunately not accessible now) the plant is described in detail, and the cost of operating it is given; but while I am not able to give the cost from memory, I can say that it is only when the source of power for operating the dynamo is very convenient and very cheap, that this method of driving piles can become economical.

Yours truly, T. J. L.

[While the information contained in this letter is interesting, yet we do not imagine that any such electrical method could be permanently successful. The dynamo is not adapted to intermittent motion—not nearly as much so as a steam motor—for the reason that a great deal of the current goes to waste during the starting and stopping of the machinery. Electricity would be a very convenient motor, however, and possibly these difficulties are not insuperable.—ED. ENG. NEWS].

PERSONAL.

Col. THOMAS R. SHARP, General Manager of the Kanawha & Ohio R. R., has resigned his position.

W. G. PROVINES, who recently resigned his position as City Engineer of Cheyenne, Wyo., which he had held for nine consecutive years, has gone to reside at Fort Worth, Tex.

Mr. FRANK SMITH, who has filled the position of foreman at the Cincinnati Southern R.R. shops at Ludlow, Ky., has resigned to accept the position of Master Mechanic of the Peoria, Decatur & Evansville R. R., with head-quarters at Mattoon, Ill.

Ex-Gov. ALEXANDER H. HOLLEY, the father of the well known civil engineer of the same name who introduced the Bessemer steel process into this country, died at Lakeville, Conn., on Oct. 2, aged 83 years. The elder Mr. HOLLEY was Governor of Connecticut in 1857 and the founder of the Holley Manufacturing Co., of Lakeville. His father, JOHN MILTON HOLLEY, is said to have cast the first iron cannon made in this country.

Messrs. SAMUEL REA, THEODORE LOW, A. R. FILLEBROWN and JOSEPH CLINE, all civil engineers, were the recipients of a banquet in Pittsburg lately, given by contractor T. CAVAN in honor of a twelve-year deferred final estimate on a Government sea-wall. The menu was said to be an excellent one, and there is not the slightest doubt about the reported good time over it by the score or more of engineers present. They always have a good time over a good dinner.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The monthly meeting, Oct. 6, was an unusually important one, chiefly devoted to business; elsewhere noted, viz.: the formation of a committee to draft an amendment to the Constitution to prevent abuse of the blackballing power, and the reception of the report of the Committee on Organization of the Society, which is given elsewhere. But one brief

discussion was read. The following members were found elected:

FOR MEMBERS:

HENRY ST. LEGER COPPEE, (Lehigh Univ., 1872,) formerly Res. Engr. Texas & Pacific R. R.; Asst. Supt. Penn. R. R.; with Bethlehem, (Pa.) Iron Co.; U.S. Asst. Engr. in local charge impt. Vicksburg Harbor, now Civil Engineer, Vicksburg, Miss.

HENRY CLAY DERRICK, formerly Res. Engr. Richmond & Danville R.R.; Res. Engr. Pittsburg, Mayaville & Cincinnati R.R.; U.S. Dep., Surv. for Kansas and Nebraska; Asst. U. S. Engr Harper's Ferry Armory; Lieut. and Cap. of Engrs., Army of Northern Virginia; Res. Engr. Western N. C. R. R.; Engr. in charge extension Richmond, Fredericksburg & Potomac R. R.; Washington City, Cincinnati & St. Louis R. R.; Lieut. Col. Engrs. Egyptian Army: Chf. Engr. Danville & New River R.R.; Asst. Engr. East. Extension Chesapeake & Ohio R. R.; Engr. in charge branches Richmond & Allegheny R. R.; Div. Eng. Louisville, New Orleans & Texas R. R.; now in charge of preliminary surveys Lynchburg, Halifax & North Carolina R. R., Halifax Court House, Va.

JOSEPH NORTON GREENE, formerly engaged on Michigan Central R. R.; Asst. Engr. Genesee Valley Canal; Asst. Engr. N. Y. State Works; Asst. Engr. Erie R. R.; Loc. Engr. Albany & Susq. R. R.; Asst. and Asst. Engr. Atlantic & Great Western R. R.; N. Central and Missouri Pacific R. R.; Mining and Civil Engr. in Lake Superior Co.; Chf. Engr. Portage Lake & L. Superior Ship Canal; Chf. Engr. Jacksonville, Pensacola & Mobile R. R.; Chf. Engr., afterwards Engr. and Manager Grand Southern Ry., of New Brunswick, Can., Chf. Engr. New York & Boston Rapid Transit R. R.; now Chf. Engr. and Pres't. Maine Shore Line R. R.; Willimantic, Conn.

EDWARD BUCKINGHAM GUTHRIE, (Elected Associate Sept. 3, 1884,) formerly Assist. Engr. in charge of Sewers; now Depty. City Engr., Buffalo, N. Y.

CHARLES EDWARD HEWITT, (U. S. Mil. Acad., 1880) engaged in Bridge Dept. New Jersey Steel & Iron Co.; now Engr. New Jersey Steel & Iron Co., Trenton, N. J.

WYNKOOP KIERSTED (Rens. Pol., 1860), formerly engaged on U. S. Imp. Missouri River at Brownville & Omaha, Neb.; Sup. and Asst. Engr. Water-Works, Fairfield, Ia.; Asst. Engr. Water-Works, Street Grades and Sewerage System, Elgin, Ill.; Cons. Engr. Water-Works, Fairfield, Ia.; in Rest. Engr.'s office Union Pacific Ry.; now engaged in general engineering work and designing water-works for Falls City, Neb.

JAMES IMBRIE MILLER, formerly Sup'g. Engr. Public Works Dept. Gov't. of India; Engr. in Chief Neemuch State Ry.; Officiating Chf. Engr. Northern State Ry.; Vice Pres't. and Gen. Man. Lykens Valley Coal Co. and Summit Branch R. R. and Mineral R. R. & Mining Co.: Div. Engr. So. Penn. R. R.; recently Chf. Engr. Survey Buffalo & Geneva R. R.; now Prin. Asst. Engr. in charge of Northern District New Croton Aqueduct, Tarrytown, N. Y.

PALMER CHAMBERLAINE RICKETTS, (Rens. Pol. 1875.) (Elected Associate, Feb. 4, 1886.) formerly Asst. Prof. of Mathematics, and now Prof. of Rational and Technical Mechanics, Rens. Pol. Inst.; Asst. Engr. Troy & Boston R. R.; Asst. Engr. Subfiltration System of Sewage at Princeton, N. J.; Inspr. of Bridges Del. & Hudson Canal Co.; Engr. of Bridges Troy & Boston R. R.; now Engr. of Bridge over Genesee River at Rochester, N. Y., for Rome, Watertown & Ogdensburg R. R., and Engr. of bridge for Monroe Co., N. Y.

GRANVILLE WHEATON SHAW, formerly Asst. Engr. Louisville Cincinnati & Lexington R. R.; Louisville, New Albany & St. Louis R. R.: Asst. City Engr. Louisville, Ky.; engaged in preliminary work of survey of Falls of Ohio River; Louisville & Portland Canal; now U. S. Asst. Engr. in charge Improving Falls of Ohio River at Louisville, Ky., and enlargement of Louisville & Portland Canal Louisville, Ky.

FOR ASSOCIATE:

GRATZ MORDECAI, formerly Asst. Engr. Baltimore & Potomac R. R.; Rest. Engr. Phila. & Erie R. R.; Asst. Eng. Sharon Ry.; on Atlantic & Great Western R. R.; Pittsburg & Northwestern R. R.; Asst. Engr. Buchanan & Clifton Forge R. R., and repairs of James River & Kanawha Canal in Virginia Assist. Engr Surveys and right of way New York, West Shore & Buffalo Ry.; recently engaged on Statistical work reporting on methods of railroad operation; now Expert of U. S. Bureau of Labor, Washington, D. C.

Report of the Committee on Organisation of the American Society of Civil Engineers.

The following report was presented at the last monthly meeting Oct. 6. The committee reported that they had been a little pressed for time and might be glad to make one or two verbal or minor changes before the amendments go formally before the Society at the November meeting, and they were continued for that purpose. A few such changes seem desirable, but it is not likely that they will be of any great importance.

TO THE PRESIDENT AND MEMBERS OF AMERICAN SOCIETY OF CIVIL ENGINEERS:

Your committee appointed under a resolution adopted at the meeting of the Society held at the Hotel Kaaterskill, July 6, 1887, "To consider and report at the meeting on the first Wednesday of October, 1887, as to the advisability of adding a new grade of Membership to be called STUDENTS; and what alterations of the Constitution and By-laws will be required to establish such grade," respectfully reports:

That we have prepared and submit herewith Amendments to Articles XVI., XVII., XVIII, of the Constitution, and a resolution fixing the dues to be paid by those who enter the proposed grade.

In considering the advisability of creating this new grade of membership we have taken into full account the only objection that has been raised to such action; that it would lower the standard of the Society. If there be danger of such result then your committee would certainly report that the proposed action is not advisable. If membership of the Society is to remain as now established, then to add a lower grade would in a certain sense lower the average of the Society, and so afford some ground for the objection. If, on the other hand, the creation of a new grade is made the occasion of an advance in the standard of qualification for the higher grades, then the spirit of the objection is an argument for the proposed action. Another consideration influences your committee, which is, that we find scant room for a grade of Students below the requirements for the present class of Junior.

We therefore say, decidedly, that if the Society is unwilling to raise the standard of qualification required for membership in grades now established, then it is inexpedient and not advisable to create the proposed grade of Students. But if the Society is ready to raise the standard for all grades, then we say the creation of the proposed grade of Students is expedient and advisable.

To test the disposition of the Society, and with confidence that it is ready for a step in advance, we report in favor of the adoption of the accompanying amendments and resolution.

(Signed by) ROBERT E. MCMATH, Chairman.
WM. H. PAINE.
ROBERT MOORE.

[Prof. R. H. THURSTON, of the Committee, had not been heard from at the time it was necessary to present the report. His signature is also expected. The remaining member, FREDERICK BROOKS, submitted a report expressing "dissent in a few particulars," chiefly in preferring the name "Junior" to "Student" for the new grade, and in desiring that their tenure should be at the pleasure of the Board of Direction, the latter probably a mere accidental omission from the Committee report. The report, therefore, is practically a unanimous one, and probably will so appear at the November meeting.—ED.]

SUGGESTED AMENDMENTS.

[Wording of present articles left unchanged, in Roman; omitted words of present articles in [brackets]; new words and sentences in "italics."—ED.]

ARTICLE XVI. The active members of the Society shall be divided into three classes, to be styled respectively,—Members, *Associate Members* [Juniors] and Associates; and each person, when duly elected and qualified, shall receive a certificate of Membership indicative of the [peculiar] class to which he belongs.

Associate Members shall have all the rights and privileges of Members, excepting the right to hold office, or to vote upon admission to membership. Associates shall have all the rights and privileges of members, excepting the right to hold office or to vote. [Associates and Juniors shall possess all the rights and privileges of Members, except the right of voting.]

There shall also be a preparatory grade, to be designated Students of the Society, who shall have the right to attend all meetings not strictly devoted to business, and to use the library and rooms of the Society under such regulations as the Board of Direction may adopt.

They shall have by right the transactions of the Society, and the privilege of presenting papers and written discussions.

Members of the Class previously styled Juniors, shall, after March 7th, 1888, be classed as Associate Members.

ARTICLE XVII. A Member shall be a Civil, Military, Mining or Mechanical Engineer, *not less than* 30 *years of age*, who has been in active practice as such for [seven years] *at least ten years*, or has graduated [as Civil Engineer] *at a school of Engineering after a full course of study*, and been in practice *seven* [five] years, *and who continues in actual practice at the time of application for Membership*, and who has had responsible charge of work as Chief, Resident, or Superintending Engineer for at least *two* [one] years, not as a skillful workman merely, but as one qualified to design as well as to direct *engineering works* [public work].

An Associate Member [Junior] shall be *one over* 24 *years of age* who has had actual practice in some of the branches of civil, military, mining or mechanical engineering for *at least five years* [not less than two years]; or if a graduate of a *school of engineering after a full course of study* [scientific or collegiate institution] who has practiced at least *two* [one] years.

An Associate shall be *one over* 25 *years of age, who is* a manager of a railroad, canal or other public work: a geologist, chemist or mathematician; a proprietor or manager of a mine or metallurgical works; an architect or a manufacturer; or one who, from his scientific acquirements or practical experience, has attained eminence in his special pursuit, qualifying him to co-operate with engineers in the advancement of professional knowledge; but shall not himself be practicing as an engineer.

A Student shall be one not less than 18 *years of age, who is engaged in the study of engineering with the intent to become an engineer, and who has pursued that study at a technical school not less than one year, or who shall have been engaged in the study and practice of engineering under a competent engineer, for not less than two years. A Student shall not remain in that grade for more than seven years; if not elected to a higher grade his connection with the Society shall terminate at the end of the seven years.*

ARTICLE XVIII. Insert after "Society" at an end of first line of printed copy the words, "except to the grade of Student."

Also, insert at end of first paragraph, "Nominations for Students shall be made out as for other grades, but the endorsement may be signed by a Member, Associate Member or Associate, and but one such signature will be required. Such nominations shall follow the usual course of procedure for other grades except submission to a letter ballot. The Board of Direction shall elect or reject the applicant."

RESOLUTION FIXING ENTRANCE FEE AND ANNUAL DUES FOR ASSOCIATE MEMBERS AND STUDENTS.

Resolved—In the event of the Society adopting amendments to the Constitution creating the grades of Associate Members and Students of the Society that the entrance fee and annual dues of Associate Members shall be the same as established for Associates: For Students no entrance fee shall be required, and the annual dues shall be, for resident Students $10, and for non-resident Students $6 per annum.

SUPPLEMENT TO REPORT OF COMMITTEE.

Stating reasons for the several changes and alterations in the Constitution that are proposed.

ARTICLE XVI. *Designation of Classes.*—It will be observed that the designation of the several classes is similar to that of the Institution of Civil Engineers, and, we may say also, to that adopted by the recently organized Canadian Society of Civil Engineers. Uniformity of designation and in the standard of qualification for the several grades, ought to be aimed at by the leading engineer societies. We think these designations appropriate.

Definition of Rights.—We think it well to give Associate Members superior rights to Associates, but materially less than Members. The rights of Students are secured.

Junior Class Abolished; its Members Transferred to Associate Members.—This change will work no hardship, except to those who are enamored with the lower grade. The Society should put pressure on such to move along. Some of the recent admissions to the Junior class will get into Associate Membership under age, but this is no hardship to them.

ARTICLE XVII.—*Qualifications for Membership.*—The age specified, 30, is thought by your Committee to be a fair compromise between various suggestions, mostly higher. The thought is, that admission to full Membership is a final endorsement by the Society of the man, and that his character should be fixed by experience, under the test of actual life for several years. Membership will thus have a meaning and value, and its attainment will be an object to be sought. In the experience qualification the aim is to give decided preference to those who enter the profession with the advantage of a technical education.

The extension of experience, from 7 to 10 years, and of responsible position, from 1 to 2 years, is an intended advance in the required qualifications.

Qualifications of Associate Members.—This is a decided advance in age and experience over that required for the present class of Junior.

Qualifications of Associates.—Except the requirement of 25 years, the qualification for this class is unchanged.

Qualifications of Students.—A decided advantage is allowed the student from a technical school, since there is now little excuse for any young man who would enter the profession without the advantage of a technical education. We have thought it well to fix a time, instead of age limit to continuance in this grade; otherwise those who graduate young and immature would have the advantage of older students. The grade of Associate Member should be fairly open to the student before his studentship terminates.

ARTICLE XVIII. *Nomination and Election of Students.*—But one endorser is required, and he may be any grade higher than student, because young men cannot be well known except by those with whom they have been associated in the capacity of pupil or subordinate.

Their election is left to the Board of Direction to emphasize the fact that Students are not Members of the Society, but are probationers, and subject to the Board of Direction for admonition and discipline.

Subscriptions to the Building Fund are to date, as follows:

Subscriptions previously reported	$3,410
John F. O'Rourke	50
A. P. Kirtland	25
	$3,485

LATEST CHANGES OF ADDRESS, AMERICAN SOCIETY OF CIVIL ENGINEERS.

WILLIAM H. ATWOOD, 617 E. Second street., Jamestown, N. Y.

GEORGE M. FARLEY, Engr. Maint. Way, New York & New England R. R., Hartford, Conn.

GEORGE S. MORISON, 205 La Salle street, Chicago, Ill.

MARSHALL MORRIS, P. O. Box 127, Lynchburg, Va.

O. SONNE, Colorado Springs, Col.

The International Institute, for Preserving and Perfecting Weights and Measures, will hold its annual meeting on Nov. 8 and 9, at Cleveland, Ohio. Mr. CHAS. LATIMER is the President.

BOOK REVIEWS.

A Treatise upon Cable or Rope Traction as Applied to the Working of Street and Other Railways. By J. BUCKNALL SMITH, C. E., London, Engineering; New York, John Wiley & Sons.

The whole modern cable system sprung from the lines constructed in San Francisco, Cal., in 1873, and these sprung only from the absolute necessity of operating grades impracticable for horses or locomotive motors. But for this fortunate fact it might have been left to a future generation to invent the cable road, for it is rare that a great invention can be traced so distinctly to origin at one place and time only. For fifty years before, vague plans of the kind had floated through the mind of various persons, as a chronological table in the first chapter of this volume shows; but before 1873 there was nothing worthy of being called even a beginning, and after 1874 or 1875 there was little left to do, except to copy San Francisco's practice.

Chicago led in copying it, as might have been expected, and was the first to apply the system to level lines, in 1882-3. The Brooklyn bridge, New York, and a short line with some silly defects, in Philadelphia followed in 1883, and since then a multitude of lines have been constructed in various cities. New Zealand also opened a line in 1883, one in London was opened in 1884, Melbourne and other cities followed in 1885,—and it is only 1887 now.

It hardly needs this brief sketch to show that cable railways have already become a recognized and important department of civil engineering, and yet that there has been but a very brief time for practice to so solidify, and experience to so accumulate, as to make it practicable to write a worthy treatise upon cable traction. Bearing this fact in mind, this book must be admitted to be a remarkably creditable and complete manual. It is somewhat sketchy and unbalanced, as is inevitable from its manner of compilation, which was by the mere combining together of separate articles which appeared chiefly if not wholly in *Engineering*, but they were very good articles, prepared with something like a uniform plan, and the result is that one does not need to go much outside of this one book to learn all there is to be known in regard to cable railways and all their details.

Some gaps we notice, but they are trifling ones, and largely due to the rapid progress of the art. The Tenth Avenue line, New York, the Brooklyn bridge machinery, the reconstructed Philadelphia line and the Kansas City plant, all present features which were worthy of fuller description and illustration. The new Rasmussen sprocket wheel cable system is not even mentioned. A tabulation of the main details of all the existing cable roads ought certainly to have been included. Fuller tabulations of cost, earnings and maintenance would have been a boon to projecting engineers, and should have been easily obtainable. But we are too glad to have all the main facts as to cable railways collected in one volume for our own reference to be disposed to be critical, and we can cordially recommend the work as one which no engineer's library should be without if he is interested in the subject at all, as every engineer should be.

The great bulk of the book is based of necessity, on American experience, the foreign lines being for the most part mere copies of them, and this being so it is mortifying that we should have to go abroad for worthy records of our own practice, but in default of a good American treatise we rejoice that Englishmen have done what Americans have as yet failed to do.

We are by no means clear that the cable system is destined to anything like universal use, even for working steep grades, and we have not the least expectation that it will ever be very largely used for level lines; it is cheaper than horses for such lines, only when the traffic is very heavy, and it appears to us extremely probable that electricity is to be the coming motive power for most of such lines. But wherever it is indispensable to secure *uniform* motion, as on the Brooklyn bridge, and wherever there is a very heavy tonnage to move up a hill and then down again, the cable system has great possibilities, which will ensure its continued use on a very large scale.

PUBLICATIONS RECEIVED.

Informe de los Trabajos Municipales durante el Ano de 1886, presentado al Señor Jefe Politico del Canton por el Presidente de la Corporacion Municipal de Guayaquil 1887.

This municipal report is in every way a most creditable production, dealing especially with the question of water supply. Guayaquil suffers from the unusual embarrassment of having more head than it knows what to do with, and is consequently obliged to let its water down easy by the aid of an intermediate reservoir at a lower level. From that it is distributed to the town by an 11-in. main, a mile or more of which is to be submerged under the Guayas river by the system of Mr. JOHN F. WARD, of Jersey City, who has the contract for that part of the work. We should be glad to see al our American reports present as full and as ably prepared technical details.

Elementary Text Book of Physics. By Prof. WM. A ANTHONY, Cornell, and Prof. CYRUS F. BRACKETT, College of New Jersey. Third Edition, revised and enlarged. New York. John Wiley & Sons, pp. 527, 8 vo. 152 cuts, $4.00.

This new edition of an excellent text-book we have heretofore noticed. The changes have not been especially important.

Fire Bricks.

Mr. W. Y. DENT, F. C. S., in the Cantor Lectures before the Society of Arts (England) speaks as follows about fire-brick :

The plastic clays consist of silica and alumina, chemically combined with water. They are hydrated silicates of alumina, their plasticity depending upon the water that enters into their composition. The water with which the clay is mechanically combined can be expelled at a temperature a little above that of boiling, without detriment to its plasticity, but the whole of the water it contains cannot be driven off without raising the temperature to dull redness. Silica, alumina and lime are all separately very infusible substances, and are capable of resisting exposure to very high temperatures without softening. It is on account of its extreme infusibility that lime is found to be the most suitable material for the cylinders upon which the oxyhydrogen flame is made to impinge to produce a brilliant light, the intensity of the light being due to the extremely high temperature to which the lime is raised. Lime, however, from its want of cohesion, could never be brought into general use for such purposes as fire clay is employed, and this is also the case as regards silica, which requires the addition of some substance of a basic character with which it will unite, and so cause the particles to bind together.

The nearest approach to the use of silica alone as a fire-brick is in the well-known Welsh brick, made from the Dinas rock in the Vale of Neath. This material, before it was made into fire-bricks, had long been used for repairing the furnaces at the copper works of South Wales, for which purpose its peculiar property of expanding when subjected to the influence of high temperature, instead of contracting (as is the case with ordinary fire-clay), renders it particularly suitable, the cementation of the bricks being facilitated by the increase of temperature. In order to make bricks of this Dinas rock (which occurs in various conditions, from that of a firm rock to that of disintegrated sand), it is necessary to mix with it about one per cent. of lime. These Dinas bricks will stand very high temperatures, but they are more friable than ordinary fire-bricks, and will not resist to the same extent the action of basic substances, such as furnace slags containing much oxide of iron. The bricks are porous, readily absorbing moisture; hence it is necessary that furnaces built of these bricks should be gradually heated, the bricks being liable to crack if sufficient time is not allowed for driving off the moisture.

The composition of the clay used for fire-bricks is a question of considerable importance, inasmuch as its quality depends greatly upon its chemical constituents, although its power of resisting fusion, when exposed to intense heat, is affected by its mechanical condition. The same materials, when mixed together in the form of a coarse powder, will require a higher temperature to fuse them than would be the case if they were reduced to a fine state of division. For the manufacture of fire-bricks the raw clay is ground between rollers or under edge stones, or reduced to powder by means of a Carr's disintegrator, which consists of large cylinders constructed of wrought-iron bars revolving rapidly in opposite directions. The clay is then kneaded with water; old bricks or other fired ware reduced to a coarse powder, technically known as "grog," being mixed with the raw clay. This admixture of previously burnt clay renders the bricks less liable to shrink, and enables them to bear a much higher temperature without fusion than would be the case if only new clay were employed. The qualities required in fire bricks are—

1. That they should bear exposure to intense heat for a long period without fusion.

2. That they should be capable of being subjected to sudden changes of temperature without injury.

3. That they should be able to resist the action of melted copper or iron slags.

It is not to be expected that any one description of brick should exhibit all these qualities to the fullest extent, and it is therefore essential that in selecting the kind of fire-brick to be used due regard should be paid to the particular purpose for which it is required.

A fire-brick like the Dinas, containing 98 per cent. of silica, will bear exposure to a higher temperature than a Stourbridge, but it will run down sooner than the Stourbridge when in contact with melted iron slag.

Gannister is the name given to a fine grit which occurs under certain coal beds in Yorkshire, Derbyshire and South Wales, which is especially adapted for lining cupola furnaces. The peculiar black gannister from the neighborhood of Sheffield is in great request for this purpose, as, owing to the large quantity of silica it contains (from 80 to 90 per cent.), it will stand high temperatures without shrinking. The Lee Moor bricks are manufactured at Plympton, in Devonshire, from the coarser portions of decomposed granite, separated from the china clay during the process of washing. These bricks contain a large proportion of silica, and are very infusible, their power of supporting exposure to very high temperature being increased by the coarseness of the particles of disintegrated granite of which they are composed.

Fire-bricks are also made of silicious clays from granitic deposits in other parts of Devonshire. The material employed for such bricks, as well as for the Dinas, differs materially in its character from what is ordinaily understood by the term fire clay as used in the manufacture of such well known bricks as the Stourbridge, Newcastle or Glenboig; the quality of which, as regards their chemical composition, depends upon the relative proportions of silica and alumina and their freedom from iron oxide and alkaline salts, the presence of which tend to render the clay more fusible.

Statistics of Railroad Construction in States East of Chicago.

Accompanying Map No. 3 of the Progress and Prospects of Construction.

The classification by "Existing Roads" and "New Projects and Surveys" in the following list is the same as that used on our usual page of Railroad News, the latter including only the schemes and surveys of new and independent companies which have not yet begun grading. "Track laid" is of course since the beginning of the calendar year. "Construction" includes work in progress and under contract, and partially built roads which have some reasonable prospect of completion. "Surveys" includes lines on which engineers are now at work and located roads which have still some prospect of construction. By "projected" is meant a line not yet under survey, but which from all the information furnished us we conclued to

have a fair possibility of construction within a reasonable time.

We especially solicit corrections and additions to the following list and to the map, and also similar data for the Southern and Northwestern States, as maps and lists of the work in those sections are in preparation, and will be issued very soon.

Maine.

Existing Roads:

24. *Boston & Maine.*-York Harbor & Beach R. R. Track laid, Kittery to Union Bluff, 11 miles.

25. *Grand Southern Ry. of Canada.*—Projected, St Stephen, N. B., to Bangor, 95 miles.

Canadian Pacific.—International Ry.—Under construction, Holeb Pond to Mattawamkeag, 138 miles.

26. *Monson.*—Under construction, Monson Junction to Wellington, 15 miles. Projected, Monson to Greenville, 15 miles.

27. *Rumford Falls & Buckfield.*—Surveyed Canton to Rumford Falls, 13 miles.

28. *Sebasticook & Moosehead Lake.*—Surveyed, Harmony to Wellington, 15 miles.

29. *Somerset.*—Under survey, North Anson to Bingham, 16 miles.

New Projects and Surveys:

30. *Boothbay.*—Projected, Boothbay to connect with Knox & Lincoln R. R. at Wiscasset or Damariscotta, 10 miles.

31. *Boston & Quebec Air Line.*—Surveyed, Skowhegan to Bingham, 25 miles. Projected Bingham to Jackmantown Plantations, to connect with International R. R., 50 miles.

32. *Castine & Bangor.*—Surveyed, Castine to Bangor, 34 miles.

Main Shore Line.—Surveyed, Hancock to Calais and Eastport, 115 miles.

Northern Maine.—Projected, Presque Isle to a connection with Maine Central near Mattawamkeag, 100 miles

33. *Penobscot Central.*—Surveyed, Milo to Bangor, 40 miles.

34. *Rockland, Rockport & Camden.*—Surveyed, Rockland to Camden, 8 miles.

Total: Track laid, 11 miles; construction, 143 miles; survey, 266 miles; projected 270 miles.

New Hampshire.

Existing Roads:

24. *Boston & Maine.*—Surveyed, Alton Bay to Laconia, 15 miles.

35. *Central Vermont.*—Projected, White River Junction, Vt., to connect with the Cheshire R. R. opposite Bellow Falls, Vt., 40 miles.

36. *Pemigewasset Valley.*—Projected, North Woodstock to F. byan's, 20 miles.

37. *Upper Coos.*—Under construction, North Stratford to Colebrook, 14 miles. Projected, Colebrook to Canada line 9 miles; to connect with a proposed branch of the Canadian Pacific.

38. *Whitefield & Jefferson.*—Projected, Jefferson to Errol, 50 miles.

New Projects and Surveys

39. *Blackwater Valley.*—Projected, Tyler's station to Andover, 15 miles.

Total: Construction, 14 miles; surveys, 15 miles; projected, 134 miles

Vermont.

Existing Roads:

35. *Central Vermont.*—Under construction, Barre to Williamstown, 6 miles. Projected, Williamstown to Royalton, 25 miles.

40. *Clarendon & Pittsford.*—Under construction, Tinmouth to Pittsford, 20 miles.

Total: Construction, 26 miles, projected, 25 miles.

Massachusetts.

Existing Roads:

24. *Boston & Maine.*—Central Massachusetts R. R. Track laid, Barre Plains, west 20 miles; under construction, to Northampton, 21 miles; projected, Boylston to connect with Worcester & Nashua R. R. to Worcester, 4 miles. Gloucester branch extension, surveyed, Essex to Rockport, 10 miles.

41. *Chatham & Harwich.*—Under construction, Chatham to Harwich, 8 miles.

42. *East Wareham & Onset Bay.*—Under construction, East Wareham to Onset Bay Grove, 1¼ miles.

43. *New York & Massachusetts.*—Projected, Boston Corners to Westfield, 50 miles.

44. *Old Colony.*—Under construction, Matfield to Easton, 6.85 miles.

New Projects and Surveys:

45. *Haverhill & Lawrence.*—Surveyed, Haverhill to Lawrence, 6 miles.

46. *Holyoke & Springfield.*—Surveyed, Holyoke to Springfield, 7 miles.

47. *Williamsburg & North Adams.*—Projected, Williamsburg to North Adams, 25 miles.

48. *Worcester & Hartford.*—Projected, Worcester to Hartford, Conn., 62 miles; 32 miles in Massachusetts.

49. *Worcester & Hudson.* Surveyed, Worcester to Hudson, 18½ miles; projected, Hudson to Waltham, 20 miles.

50. *Worcester & Plymouth.*—Projected, Worcester to Plymouth, 60 miles.

Total.—Track laid, 20 miles; construction, 37 miles; surveys, 95 miles; projected, 195 miles.

Rhode Island.

Existing Roads:

51. *Providence & Springfield.*—Projected, Pascoag to Webster, Mass., 12 miles; 8 miles in Rhode Island.

52. *Seaconnet.*—Under construction, Tiverton to Seaconnet Point, 13 miles.

Total.—Construction, 13 miles; projected, 8 miles.

Connecticut.

Existing Roads:

53. *Hartford & Connecticut Western.*—Under survey, Tariffville to Springfield, Mass., 18 miles; 11 miles in Connecticut.

54. *Meriden & Cromwell.* Under construction, Meriden to Waterbury, 18 miles.

55. *New York & New England.*—Under survey, Derby to Hawleyville, 18 miles. Projected, Derby to Waterbury, 16 miles; also Litchfield to Winsted, 17 miles.

56. *New York, New Haven & Hartford.*—Surveyed, Derby to Woodmont, 7 miles.

New Projects and Surveys.

57. *New York & Boston Rapid Transit.*—Under survey, New York City to Boston, 193 miles; 23 miles in New York, 123 in Connecticut, 47 in Massachusetts.

Total.—Construction, 18 miles; surveys, 159 miles; projected, 53 miles.

New York.

Existing Roads:

58. *Carthage & Adirondack.*—Under construction, Jayville to Little River mines, 20 miles.

59. *Chatauqua Lake.*—Track laid, Jamestown to Mayville, 20 miles. Under construction, Mayville to Westfield, 10 miles; also Falconer to Jamestown, 5 miles.

60. *Chateaugay.*—Under construction, Loon Lake to Lower Saranac, 20 miles.

61. *Cooperstown & Susquehanna.*—Projected, Cooperstown Junction to a connection with the extension of the Ulster & Delaware R. R., 4 miles.

62. *Elmira Cortland & Northern.*—Track laid, McConnellsville to Camden, 5 miles.

5. *Grand Trunk.*—Under construction, Massena Springs to Fort Covington, 23 miles.

53. *Hartford & Connecticut Western.*—Surveyed, Poughkeepsie to Mount Ross, 28 miles.

63. *Lackawanna & Pittsburg.*—Under construction, Wayland to Geneva, 40 miles; also Doty's to Hornellsville, 10 miles.

64. *Long Island.*—Under construction, Hamill's station to Far Rockaway, 4 miles; Projected, Locust Valley to Oyster Bay, 4 miles.

65. *New York Central & Hudson River.*—Track laid Lewiston to Niagara river, 1.2 miles. Surveyed, Lewiston to Youngstown, 6 miles.

66. *New York Rutland & Montreal.*—Under construction, Leoanon Springs to connect with Housatonic R. R. at Massachusetts State line, 12 miles.

67. *Pennsylvania.*—Northern Central Ry., track laid, Canandaigua station to Cananda gua lake, 3 miles.

68. *Port Jervis, Monticello & New York.*—Surveyed: Huguenot to Summitville, 20 miles; also Wurtsborough to Poughkeepsie, 35 miles.

69. *Rome, Watertown & Ogdensburg.*—Under construction, in City of Rochester, 1 mile.

70. *Ulster & Delaware.*—Under construction, Hobart to Oneonta, 25 miles. Surveyed; Hobart to Delhi, 15 miles.

New Projects and Surveys:

71. *Canastota, Morrisville & Southern.*—Surveyed, Canastota to Oneonta, 70 miles.

72. *Columbia & Rensselaer.*—Projected, Hudson to Chatham, 15 miles.

73. *Fort Plain & Richfield Springs.*—Surveyed, Fort Plain to Richfield Springs, 28 miles.

74. *Fort Plain, Ephratah & Northern.*—Projected, Fort Plain to Garoga, 12 miles.

75. *Newburgh & Poughkeepsie.*—Projected, Newburgh to Poughkeepsie, 20 miles.

76. *Rome & Carthage.*—Surveyed, Rome to Carthage, 56 miles.

77. *Washington County.*—Projected, Greenwich to New Granville, 36 miles.

Total: track laid, 29 miles; construction, 178 miles; surveys, 281 miles; projected, 91 miles.

New Jersey.

Existing Roads:

78. *Atlantic City & Brigantine Beach.*—Under contract, Atlantic City to Brigantine Beach, 7 miles.

79. *Delaware Lackawanna & Western.*—Projected Montclair to Morristown, 15 miles.

80. *Lehigh Valley.*—Projected, New Brooklyn to Roselle, 10 miles.

65. *New Jersey Junction (West Shore transfer line).*—Track laid, Weehawken to Pa. R. R. Junction and branch to Harsimus Cove, 5 miles.

67. *Pennsylvania.*—Projected, Delaware Water Gap to Port Jervis, N. Y., 40 miles.

67. *West Jersey (Maurice River R. R.)*—Under construction, Manumuskin to Port Norris, 10 miles.

81. *Williamstown & Delaware River.*—Under construction, Glassboro to Mullica Hill, 7 miles.

New Projects and Surveys:

82. *South Amboy, New Brunswick & Bound Brook.*—Surveyed, Bound Brook to South Amboy, 10 miles.

Total: Track laid, 5 miles; construction, 57 miles; surveys, 10 miles; projected, 65 miles.

Delaware.

Existing Roads:

67. *Pennsylvania.*—Philadelphia, Wilmington & Baltimore Ry., track laid, Edgemoor Cut-off, 4 miles; under contract, Christiana river bridge to New Castle, 5 miles.—Delaware Ry., projected, Dover to Rehoboth Beach, 50 miles.

Total.—Track laid, 4 miles; construction, 5 miles; projected, 50 miles.

Maryland.

Existing Roads:

83. *Baltimore & Drum Point.*—Under contract, Baltimore to Drum Point, 75 miles.

84. *Baltimore & Ohio.*—Projected, branch to Guilford City, 6 miles.

85. *Washington & Potomac.*—Under contract, Mechanicsville, to Point Lookout, 45 miles.

86. *West Virginia Central & Pittsburg.*—Baltimore & Western Ry., projected, Cumberland to Hagerstown, 65 miles.

New Projects and Surveys:

87. *Baltimore & Eastern Shore.*—Surveyed, Easton, to Salisbury, 54 miles.

88. *Deer Creek & Susquehanna.*—Projected, Aberdeen to Glen Cove and branch to Bel Air, 22 miles.

Total.—Construction, 130 miles; surveyed, 54 miles; projected, 93 miles.

Pennsylvania.

Existing Roads:

89. *Addison & North Pennsylvania.*—Phœnix Valley Ry., track laid, Phœnix to Sunderlinville, 41 miles.

84. *Baltimore & Ohio.*—Surveyed, Chester to Media 5 miles.—Fayette County Ry., surveyed, Uniontown to Point Marion, 17 miles.

90. *Bangor & Portland.*—Surveyed, Nazareth to Bethlehem, 9 miles.

91. *Bell's Gap.*—Projected, Newburgh to Kaylor, 25 miles.—Clearfield & Jefferson Ry., under construction, Mahaffey to Punxsutawney, 15 miles.

92. *Bloomsburgh & Sullivan.*—Track laid, Bloomsburgh to Benton, 19 miles; under construction, Benton to Central, 8 miles.

93. *Cornwall & Lebanon.*—Surveyed, Lebanon to New Holland, miles.

94. *Erie & Wyoming Valley.*—Track laid, Dunmore to Scranton, 2 miles.

95. *Lake Shore & Michigan Southern.*—Track laid, Youngstown, O., to Sharon, Pa., 10 miles; length in Pennsylvania, 4 miles.

96. *Lehigh & Lackawanna.*—Wind Gap & Delaware Ry., under construction, Pen Argyl to Stroudsburg, 15 miles.

Lehigh Valley.—Track laid, Luzerne to Harvey Lake 22 miles.—Surveyed, Laurel Run to Pleasant Valley 13 miles.

97. *Meadville & Linesville.*—Projected, Linesville to Andover, O., 12 miles; length in Pennsylvania, 8 miles.

98. *New York, Lake Erie & Western.*—New Castle & Northern Ry., under construction, New Castle to West Middlesex, 15 miles.—Moosic Mountain & Carbondale Ry., surveyed, Carbondale to Dunmore, 16 miles.

67. *Pennsylvania.*—Track laid, Rock Glen to Nescopec, 11.6 miles.—Under survey, Peter's creek to McDonald's Station, 26 miles.—Under construction, Frackville to Shenandoah, 5 miles.—Johnsonburg Ry., surveyed, Johnsonburg to Clermont, 18 miles.—Southwest Pennsylvania Ry., surveyed, Uniontown to State line, 75 miles.—Moshannon branch, track laid, Smoke Run to Belsena, 5 miles.

53. *Pennsylvania, Slatington & New England.*—(Now controlled by the Poughkeepsie Bridge syndicate, who also control the Hartford & Connecticut Western. Partially constructed, Slatington, east, 20 miles; also under construction in New Jersey, 23 miles; in New York, 8 miles.

99. *Perry County.*—Under construction, New Bloomfield to Duncannon, 11 miles.

100. *South Pennsylvania.*—Partially constructed, Harrisburg to Pittsburg, 213 miles.

101. *Turtle Creek Valley.*—Under construction, Stewart's station to Murraysville, 5 miles; projected, Murraysville to Saltsburgh, 17 miles.

102. *Wilkesbarre & Scranton.*—Under construction, Minooka to Scranton, 4 miles.

103. *Wilkesbarre & Western.*—Track laid, Washingtonville to Millville, 12 miles; under contract, Millville to Shickshinny, 20 miles.

104. *Williamsport & North Branch.* Under contract,

Nordmont to La Porte, 5 miles; under survey, La Porte to Dohorris' Summit, 17 miles.

New Projects and Surveys:

105. *Clearfield & Dubois.*—Projected, Clearfield to Dubois, 20 miles.

106. *Clinton County.*—Projected, Westport north, 25 miles.

107. *Hickory Valley.*—Projected, West Hickory to Camp Run, 5 miles.

108. *Nittany Valley.*—Projected, Bellefonte to Zion, 7 miles.

109. *Williamsport & Northwestern.*—Surveyed, Williamsport to Wyalusing, 60 miles.——Binghamton & Southwestern, surveyed Wyalusing to Vestal, N. Y., 40 miles.

Total.—Track laid, 80 miles; construction, 336 miles; surveys, 266 miles; projected, 107 miles.

Ohio.

Existing Roads:

110. *Cincinnati & Portsmouth.*—Projected, Georgetown to Portsmouth, 60 miles.

111. *Cincinnati, Hamilton & Dayton.*—Troy & Piqua line, track laid, 3 miles.——Columbus, Findlay & Northern Ry., projected, McComb to Findlay, 10 miles. —Louisville, Cincinnati & Dayton R. R., track laid, Hamilton to Middleton, 14 miles.——Dayton, Fort Wayne & Chicago R. R., projected, Mercer to Fort Wayne, Ind., 43 miles; length in Ohio, 15 miles.——Dayton, Eaton & Liberty line, surveyed, Dayton to Liberty, Ind., 40 miles; length in Ohio, 30 miles.

112. *Cincinnati, Jackson & Mackinaw.*—Track laid, Germantown to Carlisle, 4 miles; under construction Carlisle to a connection with Cleveland, Columbus Cincinnati & Indianapolis R. R., 2 miles.——Track laid, Cecil towards Bryan, 8 miles; under construction, present terminus to Jackson, Mich., 72 miles; length in Ohio, 32 miles.

113. *Cleveland, Akron & Columbus.*—Track laid, one mile south of Killbuck to 11 miles south of Killbuck, 10 miles; under construction, present terminus to Dresden Junction, 23 miles.

114. *Cleveland & Canton.*—Projected, Sharrodsville to Wheeling, W. Va., 45 miles.——Projected, Coshocton to Zanesville, 25 miles.

115. *Cleveland & Western.*—(In interest of Pittsburg & Western) projected, Akron to Carey, 110 miles.

116. *Cleveland, Loraine & Wheeling.*—Track laid, Bridgeport to Martin's Ferry, 4 miles, under contract, West Wheeling to Bellaire, 4 miles.

117. *Lake Erie & Western.*—Projected, Minster to Piqua, 20 miles.

118. *Marietta Columbus & Northern.*—Track laid, Amesville to Sharpsburg 5 miles; under survey, Sharpsburg to McLuney's Station on the Cincinnati & Muskingum Valley R. R., 30 miles.

119. Ohio & Northwestern.—Under construction Portsmouth to Sciotoville, 5 miles; under survey, Sciotoville to Gallipolis, 49 miles. — Columbus & Maysville extension, under construction, Sardinia to Georgetown, 12 miles; under survey, Georgetown to Ripley, 10 miles.

67. Pennsylvania.—Cleveland & Pittsburg, under construction, East Liverpool to Potteries, 1 mile.—Pittsburg, Cincinnati & St Louis. Cincinnati & Richmond Ry., track laid, Red Bank to Cincinnati, Washington & Baltimore R. R. crossing, 2 miles; under construction, C. W. & B. R. R. to Hamilton, 21 miles; projected, Hamilton to Richmond, Ind., 45 miles; length in Ohio, 33 miles.

120. Pittsburg & Western.—Pittsburg, Painesville & Fairport R. R., surveyed, Middlefield to Windsor, 8 miles.

121. Pittsburg, Marion & Chicago.—Under construction, New Lisbon to Minerva, 20 miles.

Scioto Valley.—Track laid, in Portsmouth, ½ mile.

122. Wheeling & Lake Erie.—Projected, Bowerston, O., to Wheeling, W. Va., 41 miles; also Lodi to Cleveland, 40 miles.

123. Zanesville & Ohio River.—Track laid, McConnelsville to Luke Chute, 16 miles; under construction, Luke Chute to Harmar, 25 miles.——Shawnee & Muskingum River Ry., under contract, Z. & O. R. Ry. to Shawnee, 26 miles.

New Projects and Surveys:

124. Black Diamond.—Painesville, Wooster & Ohio, surveyed, Wooster to Burbank, 28 miles; also Painesville to Pennsylvania State line, 40 miles.——Zanesville, Mt. Vernon & Marion, projected, Zanesville to Marion, 85 miles.

125. Columbus, Lima & Northwestern.—Surveyed, Columbus to Defiance, 115 miles.

126. New Lisbon, East Liverpool & Southern.—Projected, New Lisbon to East Liverpool, 14 miles.

Total.—Track laid, 73 miles; construction, 171 miles; surveyed, 354 miles; projected, 510 miles.

Indiana.

Existing Roads:

127. Chicago & Eastern Illinois.—Under contract, Momence, Ill., to Goodland, Ind., 35 miles; length in Indiana, 20 miles.

128. Cincinnati, Indianapolis, St. Louis & Chicago.—Cincinnati & Southern Ohio Ry., track laid, Lawrenceburg to Aurora, 4 miles; under construction, Aurora to Rising Sun, 11 miles; projected to Louisville, Ky., 90 miles.——Columbus & St. Louis Ry., surveyed, Columbus to Switz City, 70 miles.

129. Cincinnati, Wabash & Michigan.—Under survey, Anderson to Rushville, 37 miles.

130. Evansville & Terre Haute.—Evansville & Richmond Ry., projected, Elnora to Richmond, 120 miles.——Richmond & St. Louis Ry., projected, Elnora to Illinois State line, 25 miles.

131. Louisville, Evansville & St. Louis.—Projected, Rockport to Owensboro, Ky., 13 miles.——Huntingburg, Tell City & Cannelton Ry., under construction, Lincoln to Cannelton, 23 miles.

132. Louisville, New Albany & Chicago.—Under survey, Bainbridge to Terre Haute, 45 miles.——Orleans, West Baden & French Lick Ry., Track laid, four miles west of Paoli to French Lick Springs, 6 miles; surveyed, French Lick Springs to Jasper, 24 miles.

133. Midland Ry. of Indiana.—Track laid, Eaglestown to Ladoga, 32 miles; surveyed, Ladoga to Paris, Ill., 60 miles; length in Indiana, 50 miles.

134. Ohio & Mississippi.—Track laid, Watson to New Albany, 7½ miles.

135. Terre Haute & Indianapolis.—Track laid, Brazil to Saline City, 10 miles.

136. Toledo, St. Louis & Kansas City.—Marion & Indianapolis R. R., projected, Marion to Indianapolis, 62 miles.

New Projects and Surveys:

137. Vincennes & New Albany.—Surveyed, Vincennes to New Albany, 95 miles.

138. Vincennes, Oakland City & Owensboro.—Projected, Vincennes to Owensboro, Ky., 70 miles.

Total.—Track laid, 60 miles; construction, 54 miles; surveys, 354 miles; projected, 500 miles.

Michigan.

Existing Roads:

139. Canada & St. Louis.—Under contract, Sturgis to State line, 5 miles; surveyed, State line to Goshen, Ind., 23 miles, projected, Goshen to Danville, Ill.; length projected in Indiana, 80 miles.

140. Chicago, Kalamazoo & Saginaw.—Track laid, Kalamazoo to Hastings, 31 miles; under survey, Hastings to Saginaw, 120 miles.

112. Cincinnati, Jackson & Mackinaw.—Under survey, Clarksville to Toledo, O., 25 miles.——Also under survey, Allegan to Saugatuck, 26 miles.

142. Detroit, Charlevoix & Escanaba.—Under contract, Kalkaska to Petoskey, 65 miles; under survey, Petoskey to Mackinaw Straits, 28 miles.

143. Detroit, Lansing & Northern.—Grand Rapids, Lansing & Detroit Ry., under construction, Grand Ledge to Grand Rapids, 53 miles.

144. Flint & Pere Marquette.—Projected, Wayne Junction to Detroit, 18 miles.

145. Michigan Central.—Under construction, Pinconning to Gladwin, 20 miles.

146. Toledo & South Haven.—Projected, Hartford to South Haven, 15 miles.

147. Toledo, Ann Arbor & North Michigan.—Track laid, Mount Pleasant toward Cadillac, 38 miles; under construction, end of track to Cadillac, 30 miles.—Also, under construction, Mount Pleasant to Sherman City, 18 miles; under survey, Sherman City to Big Rapids, 24 miles.—Toledo, Saginaw & Muskegon, Ry., 40 miles; under construction, end of track to Muskegon, 45 miles.

New Projects and Surveys:

148. Alba, East Jordan & Frederic.—Surveyed, Frederic to East Jordan, 45 miles.

149. Chicago & Canada Pacific.—Under survey, Vicksburgh to Three Rivers, 15 miles.

150. Toledo, Saginaw & Mackinaw.—Under survey, Durand to East Saginaw, 60 miles.

Total.—For the portion of the State south of Mackinaw Straits.—Track laid, 109 miles; construction, 276 miles; surveys; 333 miles; projected, 113 miles.

Virginia.

Existing Roads:

151. Durham & Lynchburg.—Under contract Lynchburg to Durham, N. C., 106 miles.

152. Mineral.—Projected, Strasburgh to Moorefield, W. Va., 40 miles.

153. Virginia Western.—Surveyed, Eagle Rock to Clinch river valley near Cumberland Gap.

West Virginia.

Existing Roads:

84. Baltimore & Ohio.—Baltimore, Grafton & Charleston R. R., projected, Phillipi to Charleston, 120 miles.—Valley & Elk River R. R. projected, Beverly to Braxton, C. H., 50 miles.

154. Kanawha & Ohio.—Surveyed, Charleston up east bank Kanawha river, 36 miles; projected, to connect with Norfolk & Western R. R., near Bramwell, 80 miles.

155. Kingwood & Tunnelton.—Under construction, Kingwood to Tunnelton, 10 miles.

156. Norfolk & Western.—Surveyed, Bramwell to Ironton, O., 125 miles; length in West Virginia, 108 miles.

157. Ohio River.—Track laid, Guyandotte towards Point Pleasant, 5 miles; under construction, present terminus to Point Pleasant, 35 miles.

67. Pennsylvania.—Pittsburg, Cincinnati & St. Louis Ry., under construction, Hollyday's Cove to New Cumberland, 10 miles.——Projected, Pennsylvania State line at Monongahela river to Clarksburgh, and Weston to Charleston and Point Pleasant, 175 miles.

158. Ripley & Mill Creek Valley.—Under construction, Ripley to Ohio river, 13 miles.

159. West Virginia.—Under construction, Pennsylvania State line at Monongahela river to Newburgh, 40 miles.

160. West Virginia Central & Pittsburgh.—Under construction, Davis, southwest, 10 miles; under survey, to Buckhannon, 25 miles.

New Projects and Surveys:

161. Cumberland, Moorefield & Southwest, Virginia.—Projected, Cumberland, Md., to Moorefield, W. Va. 50 miles.

Total.—Track laid, 5 miles; construction, 118 miles; surveys, 169 miles; projected, 465 miles.

Kentucky.

Existing Roads:

162. Charleston, Cincinnati & Chicago.—Track laid, Richardson to White House, 8 miles; under survey, White House to Breaks of Sandy, 90 miles.

153. Chesapeake & Nashville.—Surveyed, Scottsville to Elizabethtown, 65 miles; also Scottsville to Stanford, 100 miles.

164. Chesapeake & Ohio.—Maysville & Big Sandy R. R., under construction, Cincinnati, O., to Ashland, Ky., 145 miles.

165. Elizabethtown & Hodgdenville.—Under construction, Elizabethtown to Hodgdenville, 11 miles.

166. Kentucky Union.—Projected, Clay City to Breaks of Sandy, 110 miles; also, Hedges station to Lexington, 12 miles.

167. Louisville & Nashville.—Under construction Bardstown to Springfield, 20 miles.

168. Louisville, Cincinnati & Virginia.—Under construction, Winchester to Beattyville, 50 miles; projected, Beattyville to Cumberland Gap, 100 miles.

169. Louisville, St. Louis & Texas.—Under construction, Louisville to Owensboro, 105 miles; surveyed, Owensboro to Henderson, 30 miles; also, branch to Hardinsburgh, 7 miles.

170. Louisville Southern.—Under construction, Louisville to Harrodsburgh, 76 miles; under survey, Harrodsburgh to Richmond, 30 miles; also, Lawrenceburg to Lexington, 25 miles.

171. Versailles & Midway.—Under contract, Midway to Georgetown, 10 miles.

New Projects and Surveys:

172. McLean County.—Projected, Rosine to Morganfield, 55 miles.

173. Madison & Southeastern.—Projected, Madison, Ind., to Danville, Ky., 100 miles.

174. Paris, Frankfort & Georgetown.—Under survey Frankfort to Paris, 35 miles; projected, Paris to Breaks of Sandy, 135 miles.

Total of above list.—Track laid, 8 miles; construction, 417 miles; surveys, 382 miles; projected, 512 miles.—The total for the State will be given with the list accompanying map of the Southern States.

Canada.

Existing Roads.—*Albert Southern.*—Under construction, Hopewell Corner, N. B., to Alma, 15 miles.

Baie Des Chaleurs.—Track laid, Metapedia, P. Q., to Nouvelle, 20 miles; under construction, Nouvelle to Paspebiac, 80 miles; under survey, Paspebiac to Gaspé, 80 miles.

1. *Brockville, Westport & Sault Ste. Marie.*—Under construction, Brockville, Ont., to Westport, 46 miles.

Buctouche & Moncton.—Under construction, Buctouche, N. B., to Cocayne river, 13 miles.

2. *Canada Atlantic.*—Under contract, Lacolle Jc., P. Q., to International boundary, 16 miles.

3. *Canadian Pacific.*—Algoma branch, Sault Ste. Marie extension, track laid, Algoma Mills, Ont., to Sault Ste. Marie, 86 miles.——Ontario & Quebec, Montreal & Smith's Falls Air Line, track laid, Montreal, P. Q., to Smith's Falls, Ont., 129 miles.——Atlantic & Northwest under construction, Lachine Bridge, P. Q., to Sherbrooke, 112 miles.——Ontario & Quebec, track laid, Woodstock, Ont., to London, 27 miles; surveyed, London to Detroit river, 112 miles.——Short Line Ry., under survey, Harvey, N. B., to Salisbury, 113 miles.——Projected, Cookshire, P. Q., to connect with Boston & Maine system at International boundary, 23 miles.

—See also *Maine*, International Ry. Totals for Canadian Pacific system east of Manitoba; track laid, 242 miles; under construction, 240 miles; under survey, 225 miles; projected, 23 miles.

4. *Carillon & Grenville.*—Projected, Carillon, P. Q., to St. Eustache, 13 miles.

Central Ry. of New Brunswick.—Under construction, Norton, N. B., to Chipman, 44 miles.

Cumberland Ry. & Coal Co.—Projected, Spring Hill, N. S., to near Oxford, 14 miles.

5. *Grand Trunk.*—Beauharnois Junction Ry. Under construction, St. Martine, P. Q., to Valleyfield, 20 miles. Lachine & Dorval, under construction, near Lachine, P. Q., to Dorval, 3 miles.——Grand Trunk, Georgian Bay & Lake Erie, projected. Hanover, Ont., to Owen Sound, 35 miles.——Also see *New York*, Massena Springs & Fort Covington. Totals for Grand Trunk system: under construction, 46 miles; projected, 25 miles.

6. *Great Eastern.*—Track laid, Yamaska, P. Q., to St. Francis, 7 miles; under construction, St. Francis to St. Gregoire, 23 miles; projected, St. Gregoire to Levis 75 miles; also Yamaska to Contrecoeur, 20 miles, also St. Philippe to Rouse's Point, N. Y., 30 miles.

7. *Guelph Junction.*—Under construction, Guelph, Ont., to near Campbellsville, 15 miles.

Intercolonial.—Pictou town branch. Track laid, Pictou, N. S., to Stellarton, 13 miles.——Cape Breton Ry. Under construction, Port Hawkesbury to Sydney, 90 miles.——Oxford & New Glasgow, surveyed, Oxford, N. S., to New Glasgow, 70 miles.

9. *Irondale, Bancroft & Ottawa.*—Under construction, Irondale, Ont., to Bancroft, 50 miles; projected, Bancroft to Ottawa, 140 miles.

L' Assomption.—Track laid, L' Epiphanie, P. Q., to L' Assomption, 4 miles.

Lake Temiscouata.—Under construction, Riviére Du Loup, P. Q., to Edmundston, N. B., 80 miles.

Long Sault & Temiscamingue.—Track laid, Foot of Long Sault on Ontario side of Ottawa river to Gordon Creek, 6 miles; under survey, Gordon Creek to Kippewa lake, 11 miles; projected, Mattawa, Ont., to Lake Temiscamingue, 91 miles.

Maccan & Joggins.—Track laid Maccan, N. S., to Joggins coal mines, 12 miles.

10. *Massawippi Valley.*—Projected, Magog, P. Q., to Ayer's Flat, 10 miles.

Montreal & Lake Maskinonge.—Under construction St. Felix de Valois, P. Q., to St. Gabriel, 15 miles.

Montreal & Western.—Under contract, St. Jerome P. Q., to Chute aux Iroquois, 70 miles.

Newfoundland.—Under construction, Harbor Grace to Heart's Delight, 10 miles; also from Main line to Placentia, 26 miles.

Northern & Western.—Track laid, Blackville, N. B., to Indiantown, 9 miles.

Nova Scotia, Nictaux & Atlantic.—Under survey, Nictaux Falls, N. S., to Lunenburgh, 75 miles.

11. *Ottawa & Gatineau Valley.*—Under construction, Ottawa to La Peche, P. Q., 20 miles; under survey, La Peche to Desert Village, 80 miles.

12. *Pontiac Pacific Junction.*—Under construction. Coulonge, P. Q., to Black river, 10 miles; under survey Black river to Pembroke, Ont., 15 miles.

Quebec & Lake St. John.—Under construction, Lake Edward, P. Q., to Lake St. John, 74 miles; under survey, Lake St. John to Chicoutimi, 30 miles.

Quebec Central.—Under construction, St. Joseph, P.Q. to International boundary, 40 miles.

St Lawrence, Lower Laurentian & Saguenay.—Under construction, Grand Piles, P. Q., to Quebec & Lake St John Junction, 50 miles.

Stewiacke Valley & Lansdowne.—Under construction Stewiacke, N. S., to Lansdowne, 40 miles.

Western Counties.—Under construction, Annapolis, N. S., to Digby, N. S., 20 miles.

New Projects and Surveys.—*Arthabaska & Wolfe.*—Projected, Dudswell P. Q., to quarries, 7 miles.

13. *Brantford, Waterloo & Lake Erie.*—Projected Brantford, Ont., to Hagarsville, 18 miles.

Caraquet.—Projected, Lower Caraquet, N. B., to Shippegan, 7 miles.

Cornwallis Valley.—Projected, Kentville, N. B., to Kingsport, 13 miles.

Drummond County.—Projected, Drummondsville, P Q., to Arthabasca, 30 miles.

14. *Iberville, Dunham & Clarenceville.*—Under survey. Clarenceville, P. Q. to West Farnham, 65 miles.

15. *Kingston, Smith's Falls & Ottawa.*—Projected Kingston, Ont., to Ottawa, 100 miles.

16. *Lake Erie, Essex & Detroit River.*—Projected, Windsor, Ont., to Leamington, 45 miles.

17. *Niagara Central.*—Projected, St. Catharines, Ont. to Niagara Falls, 13 miles.

18. *Oshawa Ry. & Nav. Co.*—Projected, Port Oshawa Ont., to Raglan, 40 miles.

19. *Port Elgin & Teeswater.*—Projected, Port Elgin Ont., to Teeswater, 50 miles.

St. John's Valley & Riviere Du Loup.—Projected, Prince William, N. B., to Woodstock, 22 miles.

20. *Southern Central.*—Projected, Stratford, Ont., to Port Bruce, 43 miles.

21. *South Norfolk.*—Projected, Port Rowan, Ont., to Simcoe, 17 miles.

22. *Teeswater & Inverhuron.*—Projected, Teeswater, Ont., to Walkerton, 24 miles.

23. *Vaudreuil & Prescott.*—Projected, Vaudreuil P. O. to Hawkesbury, Ont., 30 miles.

SUMMARY.

Provinces.	Track laid.	Construction.	Surveys.	Projected.
Ontario.....	198	111	123	602
Quebec, ...	81	601	270	223
New Brunswick,.	9	84	113	43
Nova Scotia,.....	25	150	145	14
Newfoundland,...		36		
Total,.....	313	982	651	880

CONSTRUCTION NEWS.

Water.

The Sunset Canal Co. has been incorporated at San Francisco, Cal., to maintain irrigation canals in Fresno county, by diverting water from Kings river. Capital stock, $1,000,000. The directors are GEO. F. DUFFY and E. J. DUFFY, of San Francisco; JAS. BYRNES, of San Mateo, and P. DEITLER, B. A. OSBORNE, G. W. SILL and A. N. JUDD, of Watsonville.

The Consumers' Water & Illuminating Co. of Baltimore county, has been incorporated at Towsontown, Md., with a capital stock of $200,000, to supply water and gas to the towns of Woodberry, Woodlawn, Hampden and the neighborhood. The directors are J. D. MALLORY, B. J. CAPRON, W. M. BUSEY, GEO. B. MORTON and WM. H. WATKINS.

New Orleans W. W. Co.—The President and Superintendent of this company have been examining the water-works of Kansas City, and have invited Mr. G. W. PEARSONS, the Engineer, to visit New Orleans and make examination for a similar supply there. Mr. PEARSONS goes this month.

Kansas City Water Supply.—The new reservoir at Quindaro is completed and filled once, and is now being filled a second time for the new city supply. The new machinery works admirably and the formal opening will take place in a short time.

The Hummelstown Water Co. has been incorporated at Hummelstown, Pa., by GEO. H. GROVE, FRANK S. STRICKLER, W. H. SIPLE, JOHN C. LANDIS, F. J. SCHOFFNER and M. L. BALSBAUGH. Capital stock, $5,000.

The Mount Carmel Development Co. has been incorporated at Springfield, Ill., by ROBERT BELL, E. B. GREEN, SILAS LANDES, AMOS GREEN and T. A. GREEN, with a capital stock of $3,000,000. The object is to construct and operate a hydraulic canal from some point near the mouth of Crawfish creek, to the Wabash river at Mount Carmel, Wabash county, for the purpose of supplying the city with water-works and electric light, and to afford motive power for manufacturing purposes.

The Iron King Water Co. has been incorporated at Helena, Mont., the object of which is to locate, appropriate, and use the waters of Iron King spring, situated on a mountain two miles from Spring Gulch, and six miles northwest of the Missoula river, said water to be conducted to the Iron King, Iron Queen, Silver Glance, Blue Belle, Keystone, Ivanhoe, Wasp, Toughnut, and Echo quartz lodes. The incorporators are FRANK TIBBALLS, J. C. CROMIE, W. B. WHITE, P. J. FINNEGAN, and H. W. BOYER, the first three of whom are trustees. There are only ten shares of stock to be issued, but they are worth $500 each.

New Water-Works.—*Maine.*—Bangor. Work is in progress on the extensive improvements. The new Holly engines will be put in this month.——Sanford. The pipe has been delivered and the trenches are being excavated.

Vermont.—Montpelier. The city will issue $30,000 in bonds for extending the water-works.

Massachusetts.—East Stoughton. The agitation over the proposed water supply from Stoughton still continues.——Holbrook. Water will be supplied from Great Pond by the middle of November, the estimated cost of the works is $100,000.——Beverly. A settlement has been effected by which Mr. Norman, the contractor for the new water-works, agrees to keep the new pipes in repair for 15 years and the old ones for 5 years. The supply from the Salem works will be shut off and the town supplied from its own works.——North Easton. It is proposed to authorize the issue of bonds for the extension of the water-works.

Connecticut.—Bridgeport. In consequence of troubles with the two rival companies it is proposed that the city shall purchase the franchises and property of the Bridgeport Hydraulic Co. and the Citizens' Water Co.

New York.—Bath. The water-works were tested Sept. 20 under the supervision of WM. E. HOWELL, Chief Engineer. The gravity pressure is 86 lbs., and the direct pressure 135 lbs. A stream was thrown to a height of 140 ft. The works were built by Basset Bros., of Buffalo, in an entirely satisfactory manner, and were completed 6 weeks ahead of the contract time.——Mount Pleasant. The Pocantico Water Co. is laying its pipes.——Gowanda. The water-works are being pushed forward rapidly.

Ohio.—Xenia. The new water-works have been completed.——Mount Gilead. A water supply from two large springs is being piped to the town.

Alabama.—Greenville. Water-works are projected. Address the Mayor.——Troy. A new system of works is required. Address the Mayor.——Sheffield. The water-works for the East Sheffield Land Co. will be built by the East Sheffield & Tuscumbia Water Co.——Florence. Material for the works of the Cypress Water-Works Co. is being delivered.——Mobile. The fire plugs of the water company were tested Sept. 28, to the satisfaction of C. DELAFIELD, Chief Engineer. The pressure was 90 lbs., and the streams were thrown to a height of about 130 ft.

Illinois.—Evanston. Mr. GROVER'S plan for supplying North Evanston with water has been adopted, and an ordinance is to be drawn up to cover the matter.——Lostant. Water-works are projected.——Mount Vernon. It has been voted to establish water-works, and correspondence is solicited.

Michigan.—Pontiac. Water-works will be constructed at a cost of $75,000.——East Tawas. A contract has been let for a system of water-works to cost $48,000.——Greenville. An election on the water question will be held Oct. 12.

Minnesota.—Ortonville. The vote to bond the city for $10,000 for water-works, was carried by a large majority. The bonds will be negociated and work commenced at once.——Pipestone. There is a feeling in favor of a system of water-works, to cost not exceeding $20,000, but operations will not be commenced this fall.

Wisconsin.—Hayward. Water-works are to be put in at an estimated cost of $12,000.——Kaukanna. Plans are being prepared for the new works.

Nebraska.—Fairbury. The water-works have been commenced and are to be completed in 6 months.——Holdrege. A franchise will be granted for a system of water-works. Address NELS NELSON, City Clerk.——Stromsburg. Water-works are to be constructed.——Crete. The new water-works to be built by the Strang Co., of Omaha, are to be in operation by next July.

Washington Territory.—Ellensburg. Water works are projected, but nothing definite has yet been done.

California.—San Diego. The San Diego Land & Transportation Co. will soon commence to lay ten miles of 36-in. water pipe.

Texas.—Kyle. The Kyle Water Co. has been incorporated with a capital stock of $15,000. A charter will be obtained, and work commenced, as soon as possible.

Canada.—St. Andrews, N. B. Water-works are to be built, and proposals are being received. Address T. McGrath.

Proposals Open.

Water Works.—Four miles of pipe. T. MCGRATH, St. Andrews, New Brunswick.

Pumping Engines.—For the North Side station. THE COMMITTEE ON WATER-WORKS, St. Paul, Minn.

Street Work.—Belgian block pavement and blue stone curb. G. R. CONNER, Commissioner of City Works, Municipal Building, Brooklyn, N. Y. October 13.

Wooden Pier.—Near foot of Charlton street, N. R. THE DOCK COMMISSIONERS, Pier A., North river, New York City. October 14.

Wooden Bridge.—Plans and specifications at the offices of P. WHITTY, C. E., Houston, and the County Clerk, Galveston, Tex. CHAS. H. MILBY, Houston, Tex. October 17.

Sewer.—Garrison Creek sewer. C. SPROATT, City Engineer, Toronto, Canada. October 18.

Water Works.—Construction and maintenance. Bids should state annual rental for about 135 hydrants, annual rental for additional hydrants and rates to water consumers. The system is to be combined standpipe and direct pressure. No others need apply. Plans and specifications on application. About 12.3 miles of 16 to 6-in. pipe, none smaller. Population of city, 7,000; area, 2 sq. miles; assessed valuation, $1,800,000; taxes, 2¼ per cent. EMIL BAEUSCH, City Clerk, Manitowoc, Wis. October 25.

Contracting.

Water-Works.—The contract for the water-works at East Tawas, Mich., has been awarded to the Michigan Pipe Co., of Bay City, Mich. There will be about 6 miles of improved Wyckoff pipe, 64 hydrants, 50 valves and a set of Gaskill pumping machinery, also boilers and pump house complete. The works are to be completed by January.

Dredging.—The following proposals for dredging in the Pocomoke river, Md., were opened Sept. 28 by Gen. WM. F. SMITH, U. S. Agent, Wilmington, Del.: Atlas Dredging Co., Wilmington, Del., 10 cts. per cu. yd.; American Dredging Co., Philadelphia, Pa., 11 cts.; Frank C. Somers, Philadelphia, Pa., 16 cts.; National Dredging Co., Wilmington, Del., 16½ cts.; Geo. W. Parsons, Salisbury, Md., 22 cts. The contract was awarded to the Atlas Dredging Co. All the bids are for place measurement, and include all logs, stumps, snags, trees, etc., and board and lodging for the inspector. The work is for dredging a cut-off about half a mile below Snow Hill, Md., 1,100 ft. long, 80 ft. wide and 7 ft. deep at mean low water. The amount of material to be re-

moved is about 24,000 cu. yds., and consists of soft mud with a few small stump, logs, brush, etc. The depth of cutting is from 6 ins. to 9 ft. The rise of the tide is about 2¼ ft.

The contract for dredging at Vicksburg, Miss., has been awarded by Capt. A. T. BOSSELL, U. S. Engineers, to Rittenhouse Moore, of Mobile, Ala.

Depot.—The contract for a new depot at Las Animas, Col., for the Atchison, Topeka & Santa Fé R. R., has been awarded to Riley & Bradley.

Improvement of the Bar of the Rio Grande do Sul.—We are informed that no bids have been received in this country for the work of the improvement of the bar of the Rio Grande do Sul, Brazil, proposals for which have been advertised for several weeks past.

City Improvements.—Macon, Ga., will issue bonds for $60,000 for sewers and street improvements.——Corsicana, Tex., will issue $25,000 of bonds for sewers and other improvements.

Pumping Engine.—The Water Committee, McKeesport, Pa., has awarded the contract for a pumping engine, with a capacity of 5,000,000 galls., to Snyder, Wilson & Co., of Pittsburg.

Paving Prices at Kansas City.—"The paving contractors of the city do not seem to care very much whether they secure any more contracts this season or not," remarked City Engineer DONNELLY, yesterday afternoon a short time after the contracts had been awarded. "For instance," he continued, "there is the Twelfth street contract to pave from Broadway to Penn street. This job was advertised to be let two weeks ago. But I considered the bid, $2.45 per sq. yd., altogether too high, and the letting was postponed until to-day. When the bids were opened to-day the lowest one was $2.50 per sq. yd., just 5 cts. per sq. yd. more than the lowest bid two weeks ago. The awarding of the contract was again postponed for the same reason, and unless the contractors come down a little in their prices there are a good many pavements, for which petitions have been acted upon by the council, that will have to be laid over until next spring. The lowest paving contract ever let in the city was the paving of West Tenth street, west of Broadway, at $1.10 per sq. yd."—*Kansas City (Mo.) Times.*

Water Works Contracts.—Scoville & Irwin, of Nashville, Tenn., have been awarded the contracts for the Bessemer Land & Improvement Co.'s water-works at Bessemer, Ala.

E. Sutphen, of Clyde, Kan., has the contract for the works at Greenleaf, Kan.

A. L. Strang & Co., of Omaha, Neb., have been awarded the contract for the water-works at Crete, Neb. Five bids were received.

Schroeder Bros., of Columbus, Neb., have been awarded the contract for the construction of the water-works at David City, Neb., for $22,000.

McQuillan & Co., of Toronto, have been awarded the contract by City Engineer BELL, of St. Thomas, Ont., for the construction of the water-works at Milton, Ont. The contract price was $12,000.

Cable Railroad.—The contract for the construction of the Wyatt Park cable road at St. Joseph, Mo., has been awarded to J. T. Lerned, of Plainfield, at $450,000. The contract is for 4¾ miles of road and includes the erection of the power house; it calls for the completion of the road within one year. Work is to be commenced this month, and the contractor says the road will be completed by January.

The Clayton Air Compressors.—A duplex air compressor for Japan, is included in this month's shipments of the Clayton Air Compressor Works, Brooklyn, N. Y., whose well-known machines are now in use in Spain, Russia, Australia the West Indies, Mexico, Canada, and most of the South American republics. The greater number of sales are, however, for use in this country, where the Clayton air compressors are favorites with miners and contractors. A material increase in orders is reported since these works opened their office and salesroom at 43 Dey St., New York City.

Reservoir.—The specifications for the distributing reservoir at St. Paul, Minn., contain the following list of quantities as the engineer's estimate: 6,000 cu. yds. of earth and soil put into spoil bank or grading (including earth trimmed from puddled slopes); 9,800 cu. yds. of puddled basin floor; 40,000 cu. yds. of puddled embankment and in trenches; 7,845 sq. yds. of soiling and sodding of embankment or roadway slopes; 35 cu. yds. of concrete foundations of pipes; 9,850 sq. yds. of concrete (beton) basin floor paving; 7,215 sq. yds. of concrete (beton) basin slope paving; 4,000 sq. yds. of broken stone lining; 4,345 sq. yds. of stone slope paving; 1,343 lin. ft. of coping on crest of slope paving; 40 tons of pipes, special castings and materials; 12 tons of gate valves and curbs; 1,000 cu. yds. borrowed puddling material, from outside of reservoir lot; 135 sq. yds. of cobblestone gutter paving. For the purpose only of the preliminary estimate, it is assume that puddling material borrowed from outside the reservoir lot will have 1,000 ft. haul. A copy of the plans and specifications may be seen at the office of ENGINEERING NEWS; copies may be obtained at the office of the Water Commissioners, St. Paul, and at the offices of H. H. HARRISON, St. Paul, and J. T. FANNING, Union Depot Building, Minneapolis, who are the Consulting Engineers.

Water Works Wanted.—The city of Mount Vernon, Ill., has voted to erect water-works and is now prepared to talk business with parties interested in submitting plans for the works. Correspondence, or a visit, is solicited.

Holdrege, Neb., wants a water supply and will grant a franchise for a system of water-works. Parties interested and desirous of competing for the franchise should address NELS NELSON, Village Clerk, for particulars.

Wharf.—The following proposals for the construction of a wharf at Fortress Monroe, Va., have been received by Lieut. Col. PETER C. HAINS, U. S. Engineer Office, Washington, D. C.:

Materials	Quantities	Groton Bridge Co. Groton, N. Y.		Builders Iron Foundry Providence, R. I.		Ross & Sanford Baltimore, Md.		Camden Iron Works. Phila. Pa.		Builders Iron Foundry Prov., R. I.	
Cast-iron piles	975,000 lbs.	4½c	$43,875	4.2c	$40,950	5½c	$51,187.50	2.45c	$23,887.50	2.9c	$28,275
Wrought-iron I-beams	615,000 lbs.	5c	30,750	5c	30,750	6½c	37,668.75	*5.2c	24,742.16	4.2c	25,830
Lumber	300,000 ft. B.M.	$33	9,900	$12	12,000	$45	13,000.00	.....	.....	.....	.....
Wooden bearing-piles	210	8	1,680	45	9,450	30	6,300.00	.....	.....	.....	.....
Fender-piles	120	10	1,200	35	4,200	20	2,400.00	.....	.....	.....	.....
Mooring-piles	20	10	200	25	500	20	400.00	.....	.....	.....	.....
Bulk-head	100 lin. ft.	7	700	12	1,200	7	700.00	.....	.....	.....	.....
			$88,305		$99,650		$112,156.25				

* Add ¼ ct. for painting, etc., and 10 cts. for punching.

City Work.—*Albany, N. Y.*—The following proposals were opened Oct. 3, by the Board of Contract and Apportionment: Robin street drain: Patrick Reilly, 10-in. and 8-in. pipe, 60 and 50 cts. per lin. ft.; 10-in. and 8-in. Y branches, $1.80 and $1.80 each; lamp holes, $15 each; Jacob Holler, pipe, 75 and 65 cts.; branches, $2.30 and $1.90; lamp holes, $4. The contract was awarded to P. H. Reilly. ——First street drain: P. H. Reilly, 12-in. pipe, 90 cts per lin. ft.; Y branches, $2.50 each; manholes, $45 each; lamp holes, $10 each; Jacob Holler, $1.15, $3, $75, $4. The contract was awarded to P. H. Reilly.——Partridge street plank walk: P. H. Reilly, 26 cts. per lin. ft.; Thomas Riley, 35½ cts. The contract was awarded to P. H. Reilly.

Syracuse, N. Y.—The following proposals have been received: James street sewer, lowest bid, Martin & Sprague, $22,125.56.——Gifford street sewer, lowest bid, Hugh Purnell, $4,687.50.——Hard blue or gray limestone delivered at the crusher, A. E. Alvord, of Syracuse, 1,000 cords at $2.44 per cord.——Cobblestone paving for gutters on Harrison street; Anthony McNamara, excavation, 18 cts. per cu. yd.; cobblestone paving, including sand, 5½ cts. per sq. ft.; 10-in. tile laid, 35 cts. per lin. ft.; brick catch-basins, ring, pot and grate complete, $20 each.——Cobblestone paving for gutters on Bridge street; Matthew Dillon; excavation, 15 cts. per cu. yd.; embankment, 60 cts. per cu. yd.; cobblestone paving laid, including sand, 5½ cts. per sq. ft.; 10 in. tile laid, 60 cts. per lin. ft.; brick catch-basins, ring, pot and grate complete, $17 each; macadamizing, 70 cts. per sq. yd.——Blast furnace slag; Mylcrane & Downey, 900 tons; 25, 28, 30, 35 and 45 cts. per ton, in different wards. Frank Matly, 1,650 tons, 33⅓, 38½, 50, 55, 60 and 70 cts. per ton, in different wards.

Newark, N. J.—Sewer contracts have been awarded as follows: Clinton avenue and Alpine street, Thomas O'Connor; Warren street, Hughes & Flynn; Congress and Elm streets, James Edwards; South Ninth and Jacob streets, Hughes & Flynn; Kent street, etc., B. M. & J. F. Shanley; Charlton and other streets, James McGuire; Avon avenue and Barclay street, James Conway.

Detroit, Mich.—The following proposals for the construction of lateral sewers have been received by the Board of Public Works: In the alley in the block bounded by (Champlain) Lafayette and St. Paul streets, Meldrum and Beaufait avenues: T. G. Whittaker, 57 cts.; R. Borchard, 57 cts.; John Affeld, 59 cts.; F. Porath, 64 cts.; L. Lemke, 64 cts.; John Wagner, 69 cts.; H. Maybury & Son, 83 cts.

In the alley in the block bounded north by Michigan boulevard, west by Vinewood avenue, east by boulevard and extending south to and including lot 70, Hendrie's subdivision: F. Porath, 72 cts.; John Affeld, 73 cts.; H. Maybury & Son, 78 cts.; L. Lemke, 80 cts.; T. G. Whittaker, 80 cts.; John Wagner, $1; R. Borchard, $1.15.

In the alley between Celia and Clitz streets, between Twelfth and Thirteenth streets: T. G. Whittaker, 70 cts.; John Affeld, 72 cts.; F. Porath, 75 cts.; L. Lemke, 79 cts.; M. Henderson, 80 cts.; John Wagner, 80 cts.; H. Maybury & Son, 85 cts.; R. Borchard, $1.

In the alley between Garfield avenue and Fremont street and Dubois and Chene streets, John Affeld, 76 cts.; John Wagner, 83 cts.; T. G. Whittaker, 84 cts.; M. Henderson, 85 cts.; F. Porath, 85 cts.; L. Lemke, 85 cts.; R. Borchard, $1; H. Maybury & Son, $1.16.

In the alley between Russell, Ferry and Kirby streets T. G. Whittaker, 69 cts.; John Affeld, 73 cts.; H. Maybury & Son, 73 cts.; John Wagner, 75 cts.; F. Porath, 76 cts.; L. Lemke, 79 cts.; M. Henderson, 85 cts.; R. Borchard, $1.

In the alley between Twenty-sixth and Twenty-seventh streets and Ash street and Michigan avenue: John Affeld, 69 cts.; F. Porath, 73 cts.; L. Lemke, 79 cts.; H. Maybury & Son, 83 cts.; T. G. Whittaker, 89 cts.; R. Borchard, 97 cts.; John Wagner, $1.

Kansas City, Mo.—The following contracts have been awarded:

Grading the alley between Holmes and Charlotte streets from Tenth to Eleventh streets was awarded to P. McDonald at 36 cts. per cu. yd.

Grading the alley in block 3, T. S. Case's, and block 3, Lykins' place; J. J. Armstrong at 35 cts. per cu. yd. for embankment, and $1.75 per cu. yd. for rock excavation.

Grading Bellefontaine avenue from Independence avenue to St. John's avenue was awarded to T. C. Lidwell at 18 cts. per cu. yd. for earth, $1.50 per cu. yd. for riprap and $1.20 for 18-inch pipe.

Grading Euclid avenue from Twelfth to Fifteenth street was awarded to Patrick McDonnell at 22 cts. per cu. yd. for embankment.

Grading Montgall Ave. from Eighteenth to Twenty-first street was awarded to T. F. Ryan at 26 cts. per cu. yd. for earth, and 90 cts. per cu. yd. for rock and 18-inch pipe at $1.40 per lin. ft.

Grading Chestnut Ave. from Eighteenth to Twenty-first street was awarded to Patrick O'Brien at 20 cts. per cu. yd. for embankment.

The contract for constructing sewer in district 39 was awarded to Oscar Downing at 96 cts. per lin. ft. for 10-in. pipe; $50 for manholes.

Paving Garfield avenue from the east line of Garfield avenue, south of Pendleton avenue, west and north to the north line of the south half of section 33 was awarded to Isaac Robertson at $1.65 per sq. yd.

Paving Wyandotte street from Thirteenth to Fourteenth street was awarded to G. J. Barr at $1.58 per sq. yd.

Constructing second class sidewalks on the east side of Cherry, between Second and Third streets, to J. N. White at 33 cts. per lin. ft.

Constructing sidewalk on east side of Campbell street from Nineteenth to Twenty-second to J. N. White at 29 cts. per lin. ft.

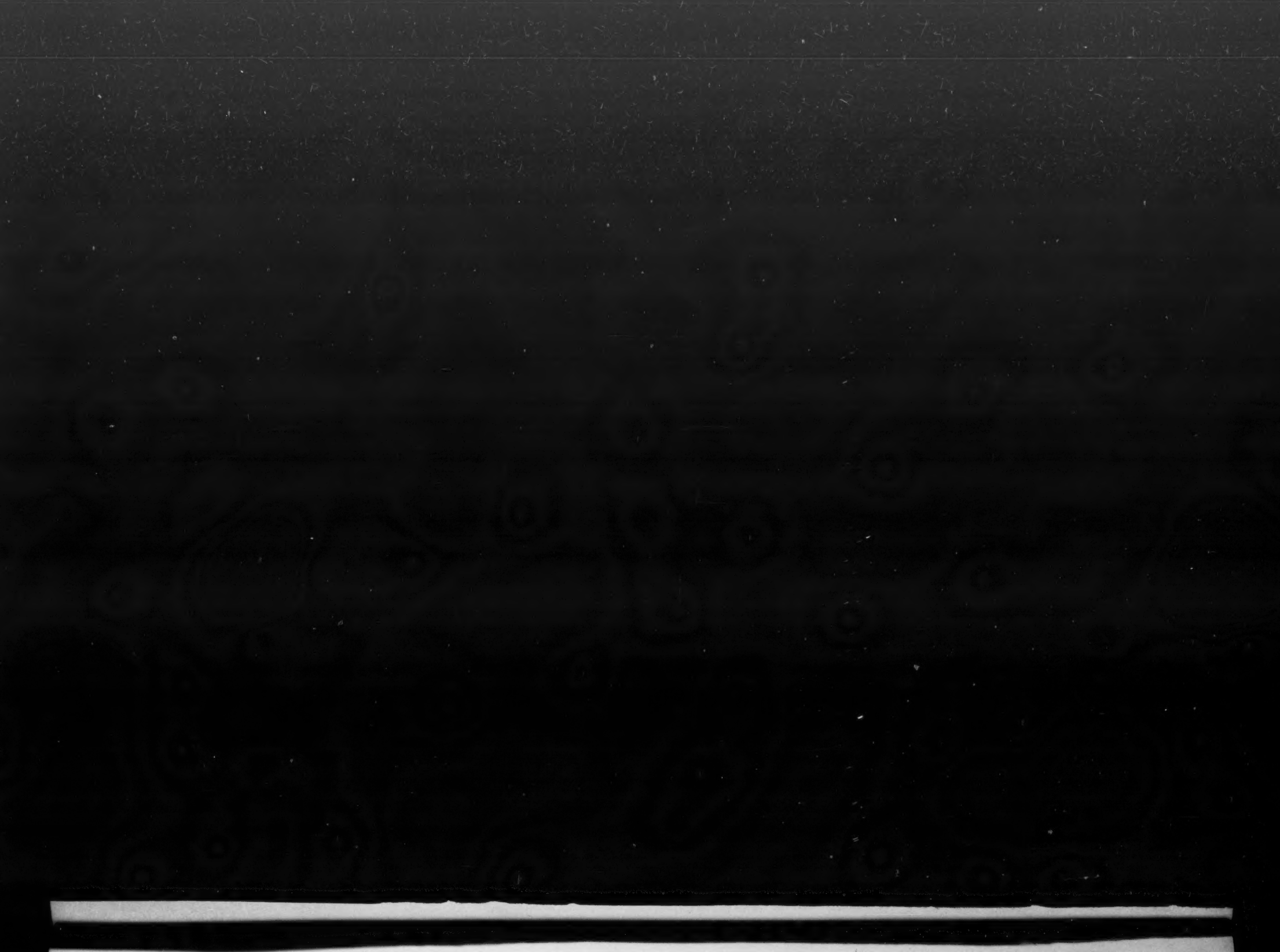
Constructing second class sidewalks on south side of Eighteenth from Bellview avenue to Holly street to O. F. Redmond at 33 cts. per lin. ft.

Constructing second class sidewalks on west side of Virginia street from Twelfth to alley south was awarded to C. M. Cravens at 29 cts. per lin. ft.

Constructing second class sidewalks on the east side of Virginia street from Twelfth to Thirteenth street was awarded to C. M. Cravens at 32 cts. per lin. ft.

Constructing second class sidewalks on the east side of Wabash avenue from Seventeenth to Eighteenth street was awarded to Thomas Kneaves at 33 cts. per lin. ft.

The contract to put down pavement on Twelfth street from Broadway to Penn street was not let for the same reason that it was allowed to pass the previous letting without being awarded. The bid was considered altogether too high at $2.50 per sq. yd., 5 cts. more than was bid at the last letting.

RAILROADS.

We are obliged to omit this week our usual page of Railroad News to make room for the summary of work in the States east of Chicago, accompanying the map. We have only space to briefly mention a few important items. It is now acknowledged that the Manitoba officials have failed in every attempt to raise money for the Red River Valley Road. They now claim that money will be furnished in part by a popular subscription, and the remainder by the Northern Pacific.—— The Chicago, Burlington & Northern has been defeated in their suit to obtain a portion of the Illinois Central's right of way from Galena to East Dubuque, Ill., about 11 miles; and will have to tunnel the bluff to secure the desired connection.—— Tracklaying is completed on the Denver & Santa Fé from Denver to Pueblo, Col., a distance of 120 miles.